

FIG. 1

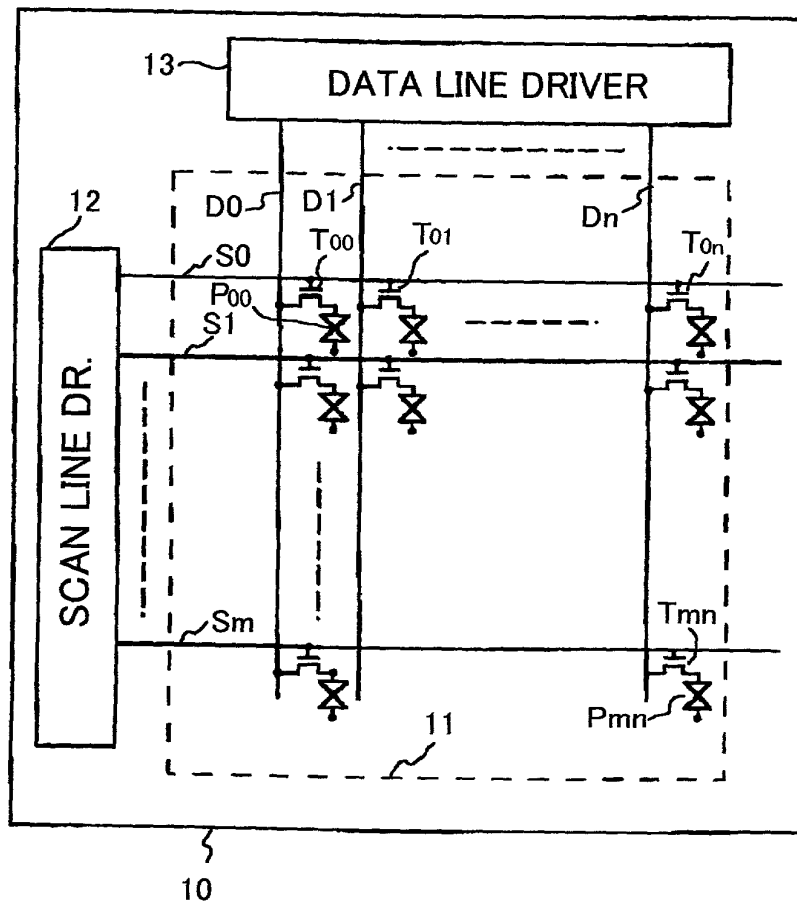


FIG. 3A

Resist deposition
 Pre-baking

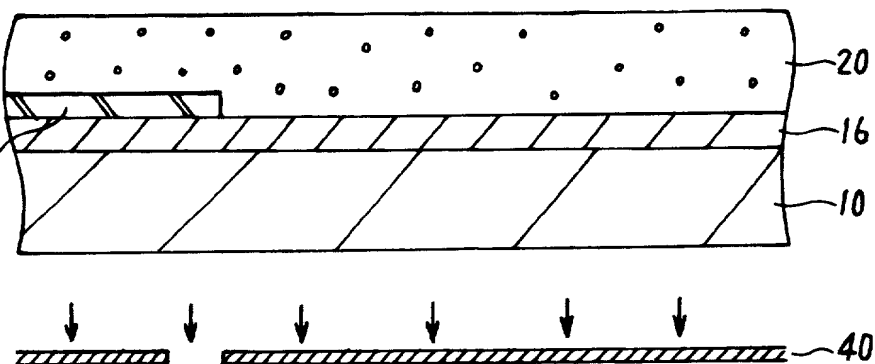


FIG. 3B

Exposure &
 Development
 for contact hole,
 Post-baking

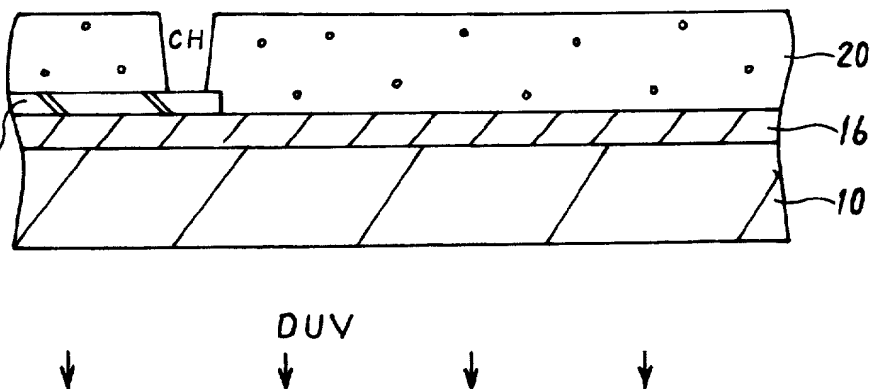


FIG. 3C

DUV irradiation

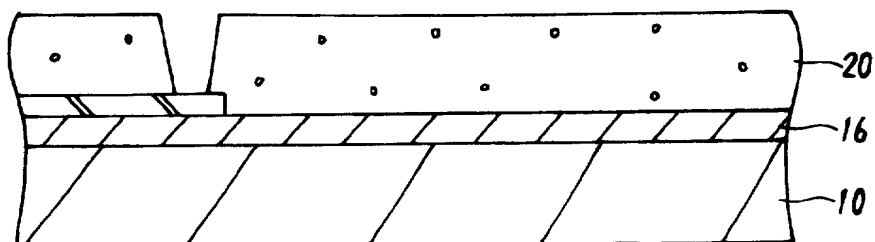


FIG. 3D

Final baking

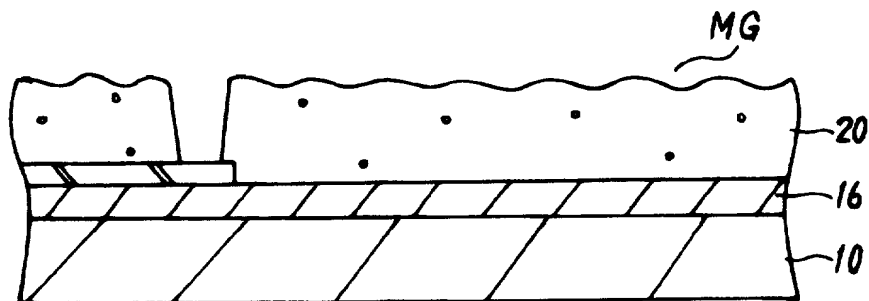


FIG. 4

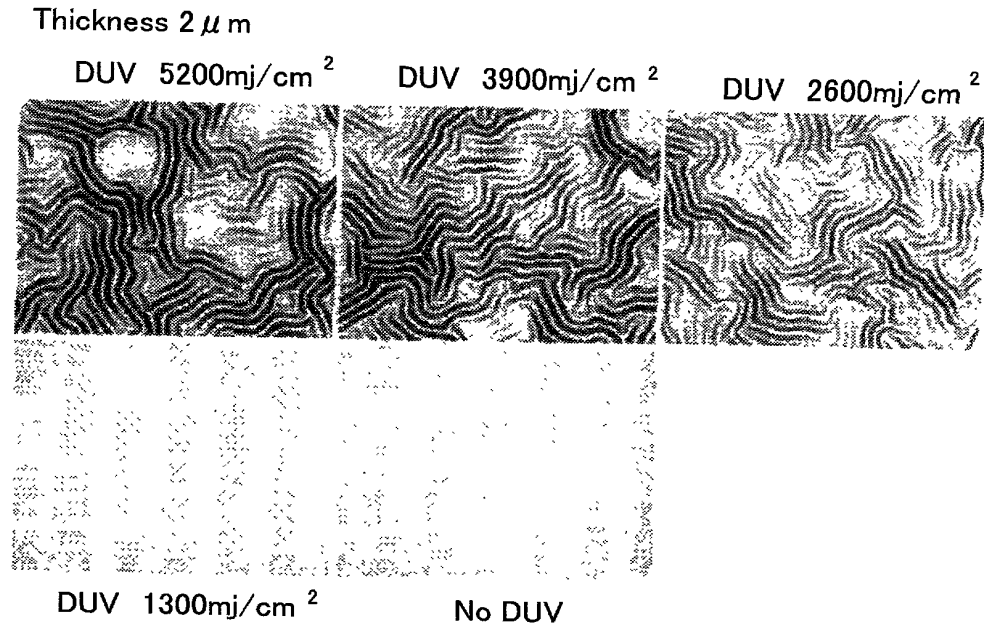
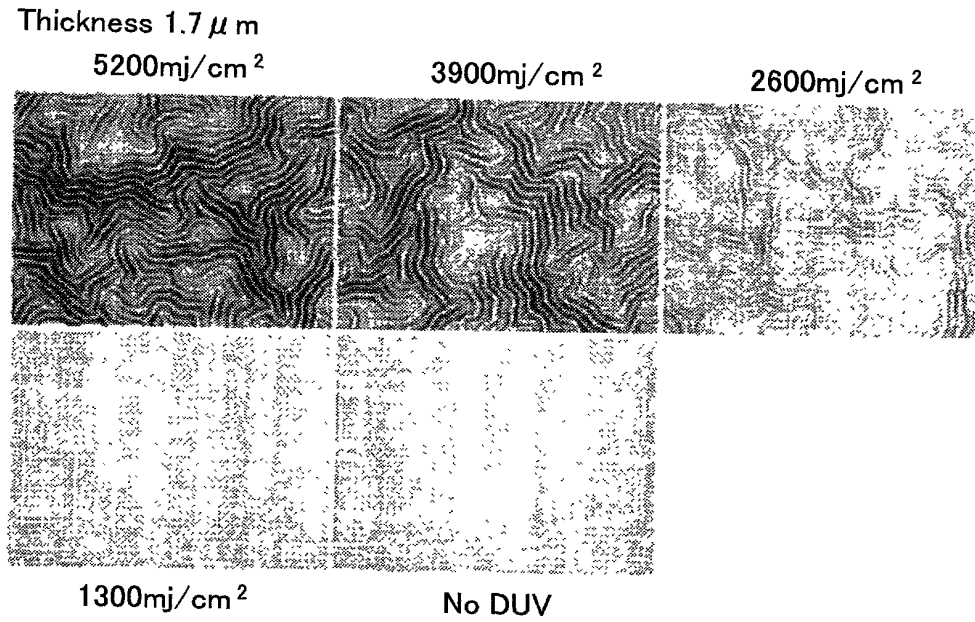


FIG. 5



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FIG. 6

Thickness $1.4 \mu\text{m}$

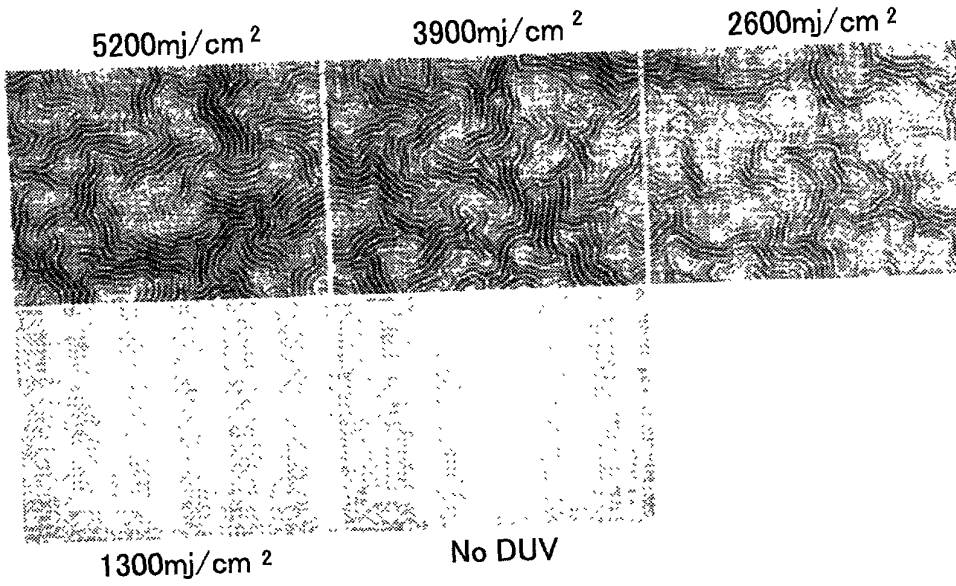


FIG. 7

Thickness $1.0 \mu\text{m}$

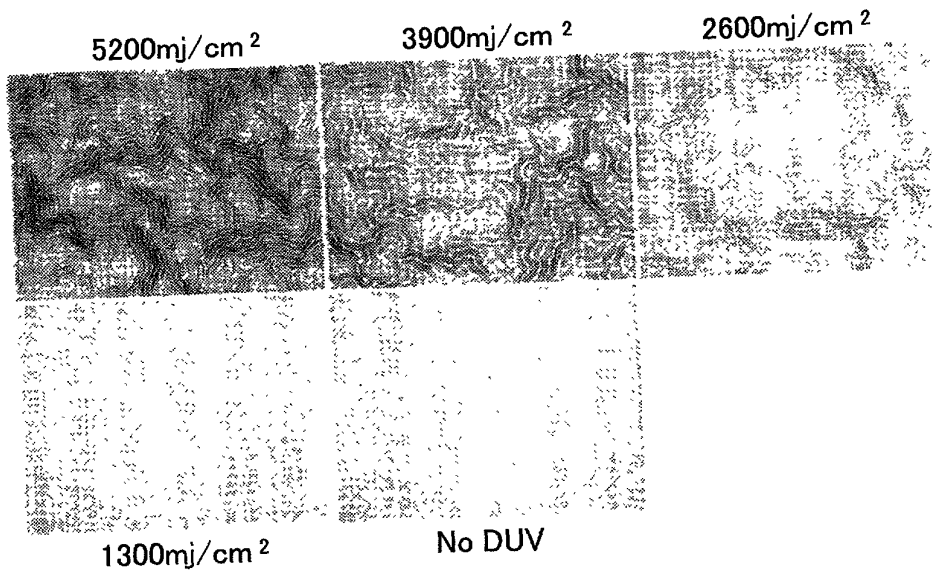


FIG. 8A

Thickness $1.7 \mu\text{m}$

Average inclination angle $k=13^\circ$

Height difference of undulation : $1.3 \mu\text{m}$



FIG. 8B

Thickness $1.4 \mu\text{m}$

Average inclination angle $k=11^\circ$

Height difference of undulation : $1.1 \mu\text{m}$

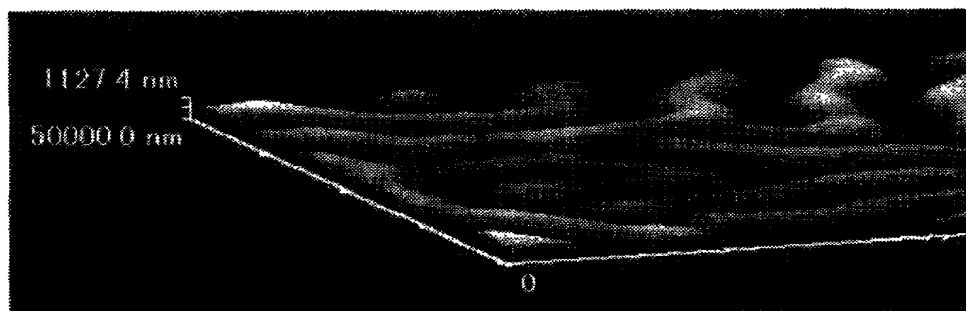


FIG. 8C

Thickness $1 \mu\text{m}$

Average inclination angle $k=8^\circ$

Height difference of undulation : $0.5 \mu\text{m}$

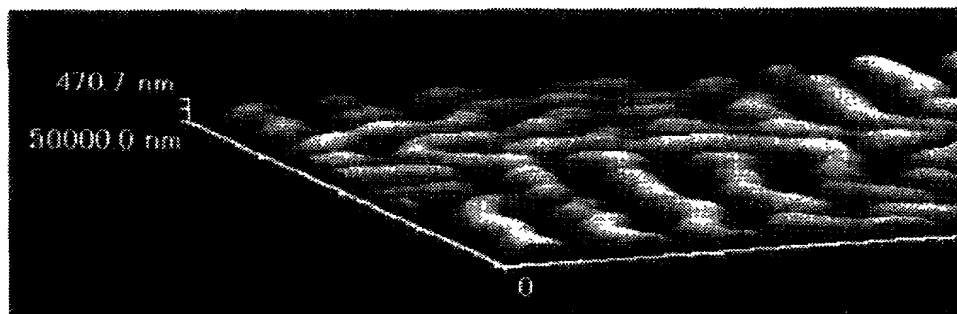


FIG. 9

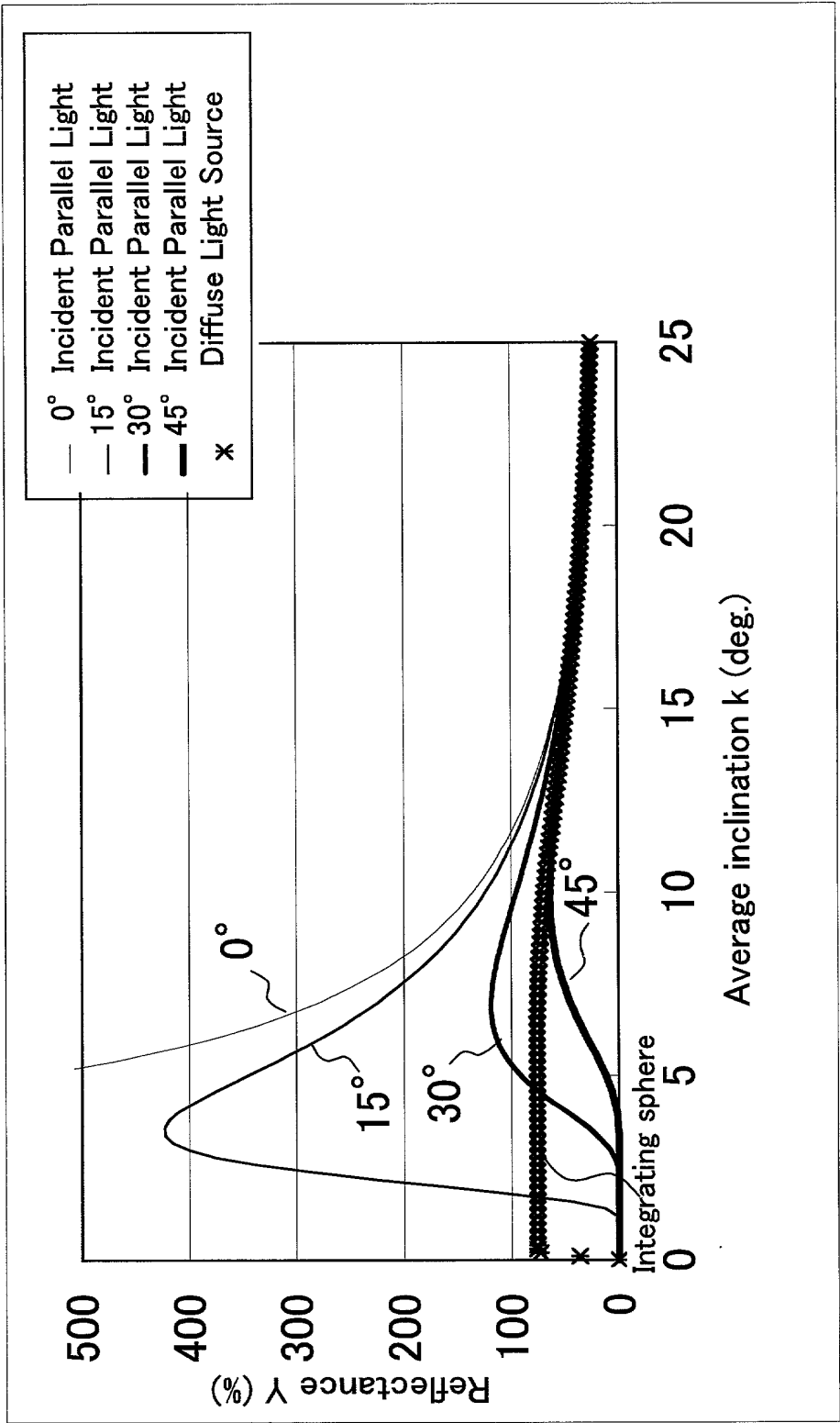


FIG. 10

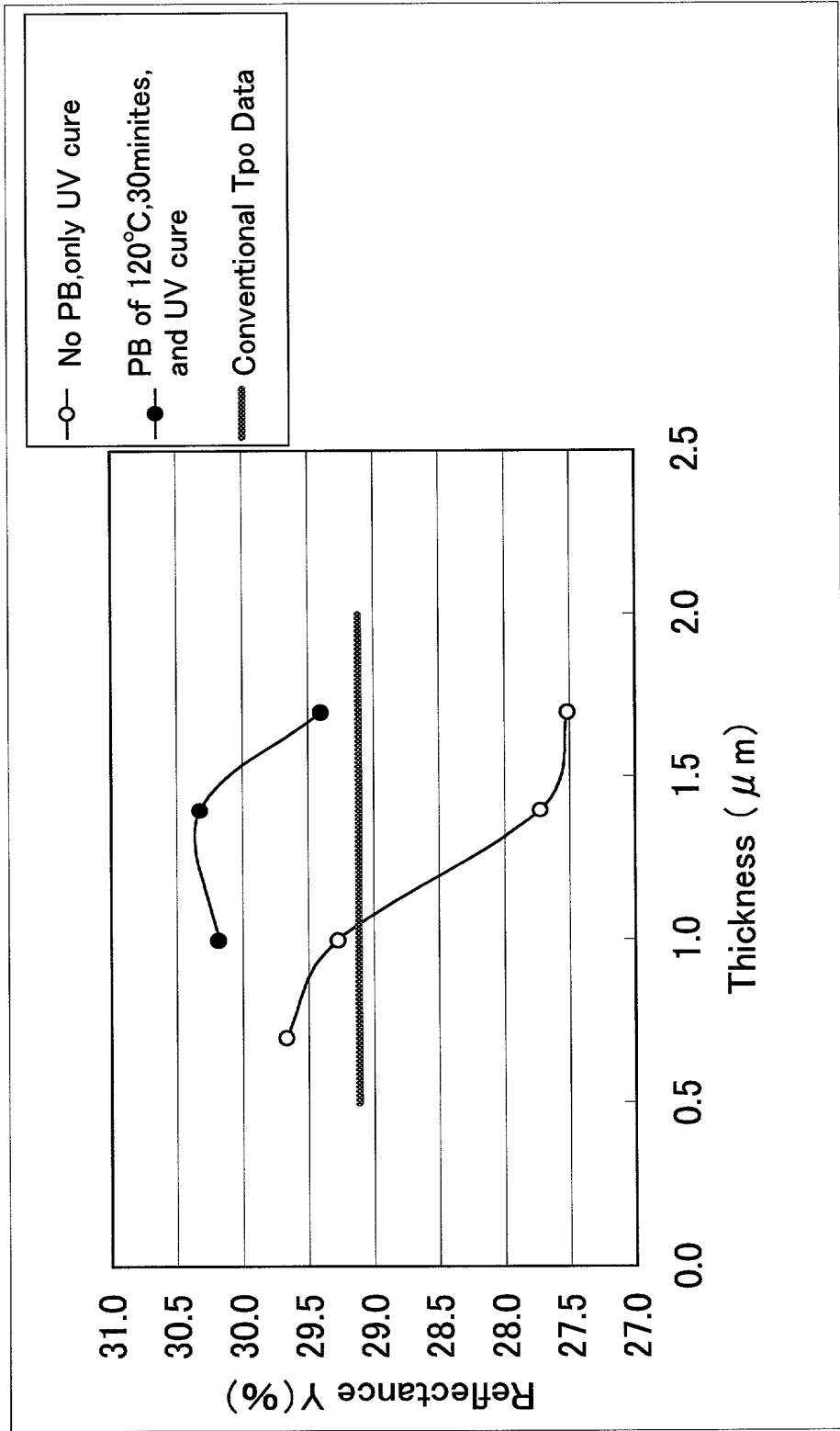


FIG. 11A

Rough undulation

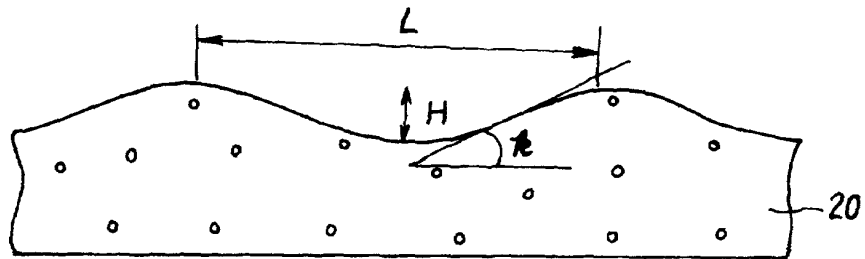
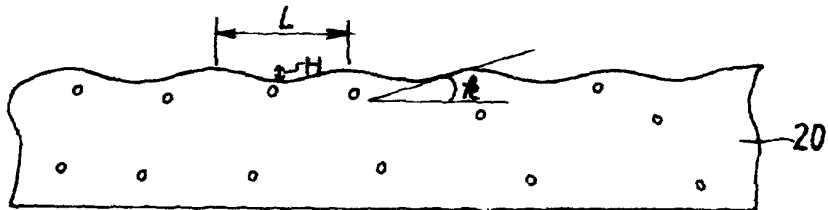


FIG. 11B

Fine undulation



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FIG. 12A



FIG. 12B



FIG. 12C

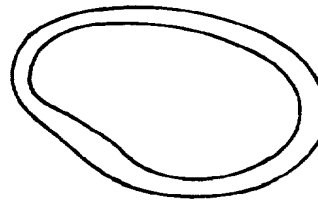
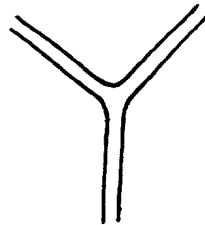


FIG. 12D



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FIG. 13A

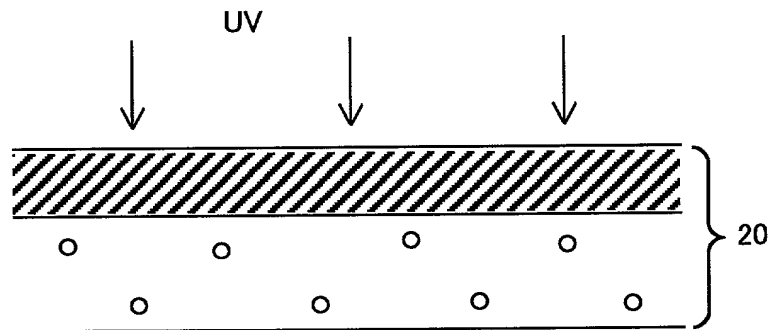
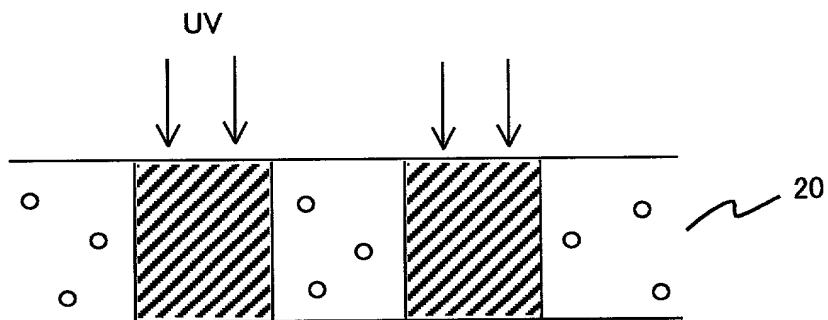


FIG. 13B



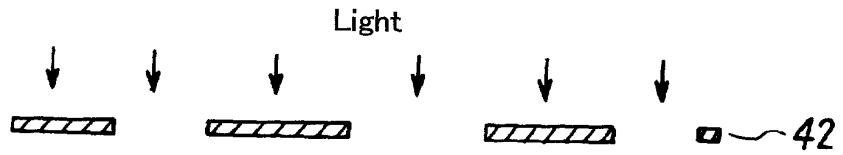


FIG. 14A

Exposure

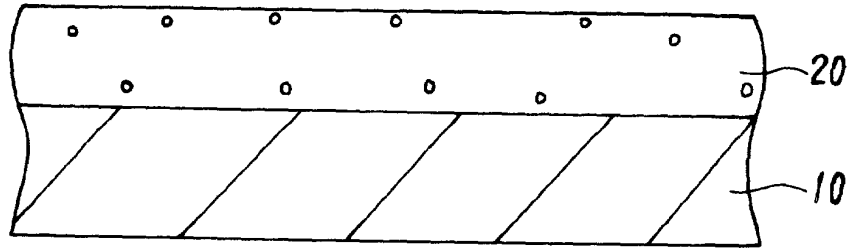


FIG. 14B

Development
UV irradiation

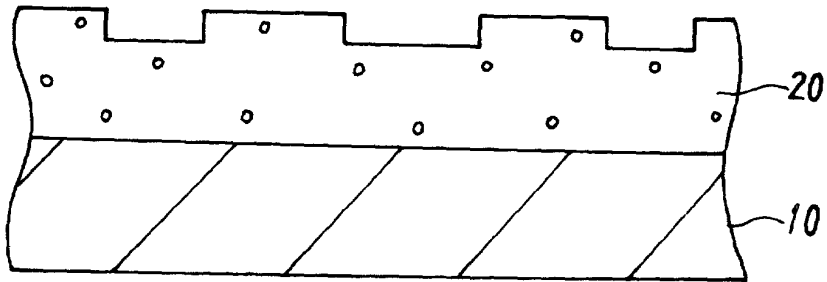


FIG. 14C

Final baking

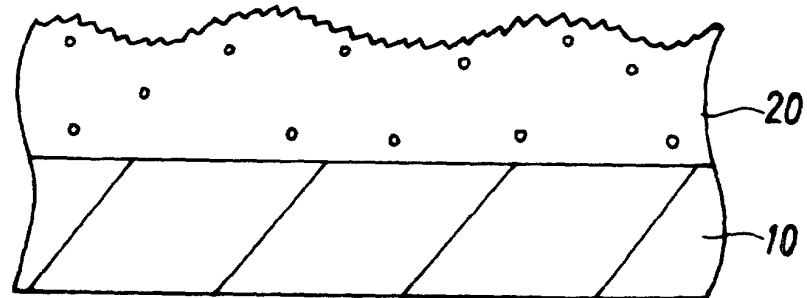


FIG. 15

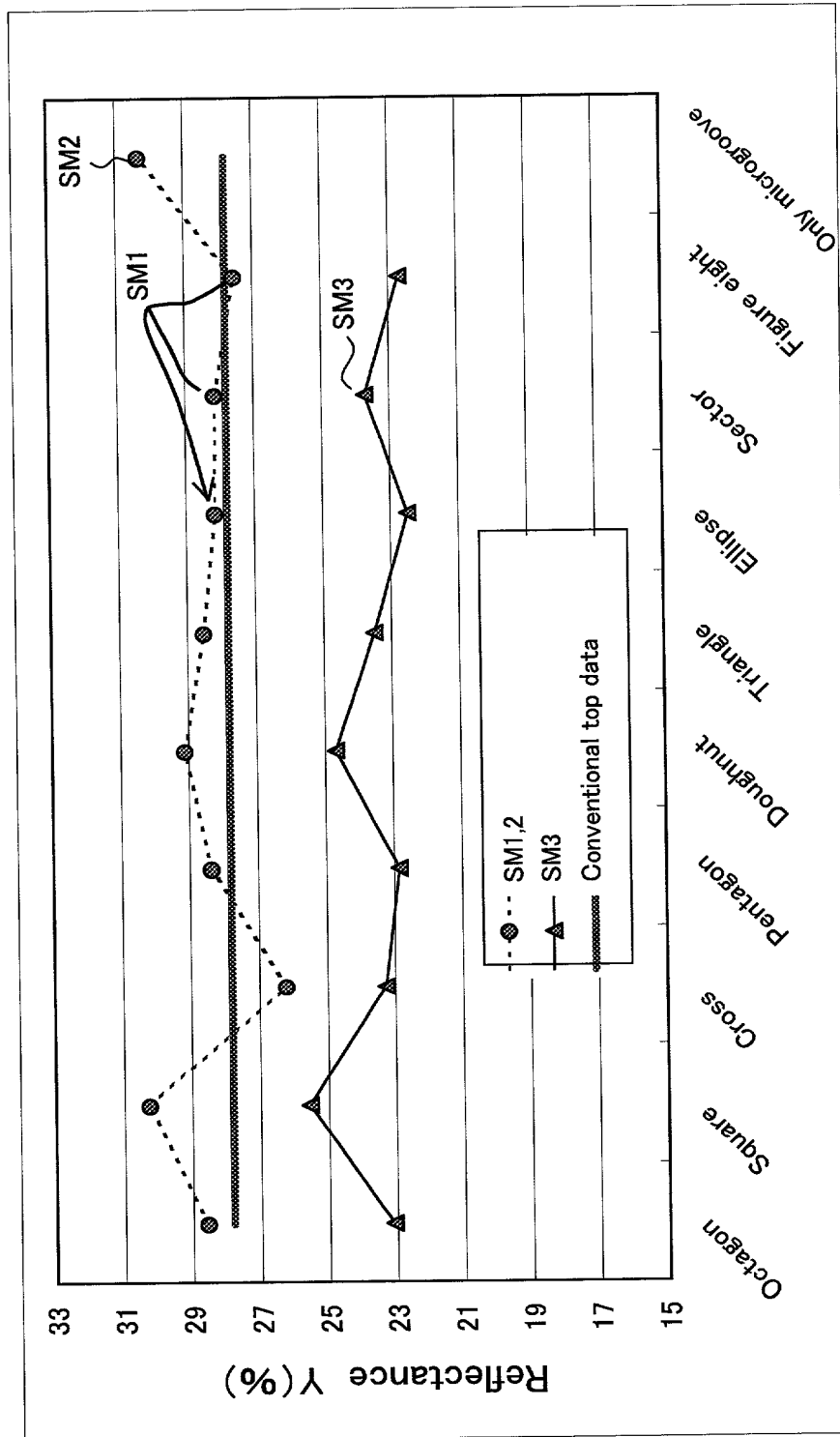


Fig. 1 is a schematic diagram of a cross-section of a substrate 22. The substrate has a central opening 24. The opening is defined by a curved line labeled 'CH'.

A diagram of a rectangular block. The top section is shaded and contains a small square on the left and a small square on the right. Below this is a section labeled 'D' and '50' with a jagged line indicating a break. The bottom section is unshaded and contains a small square on the left and a small square on the right.

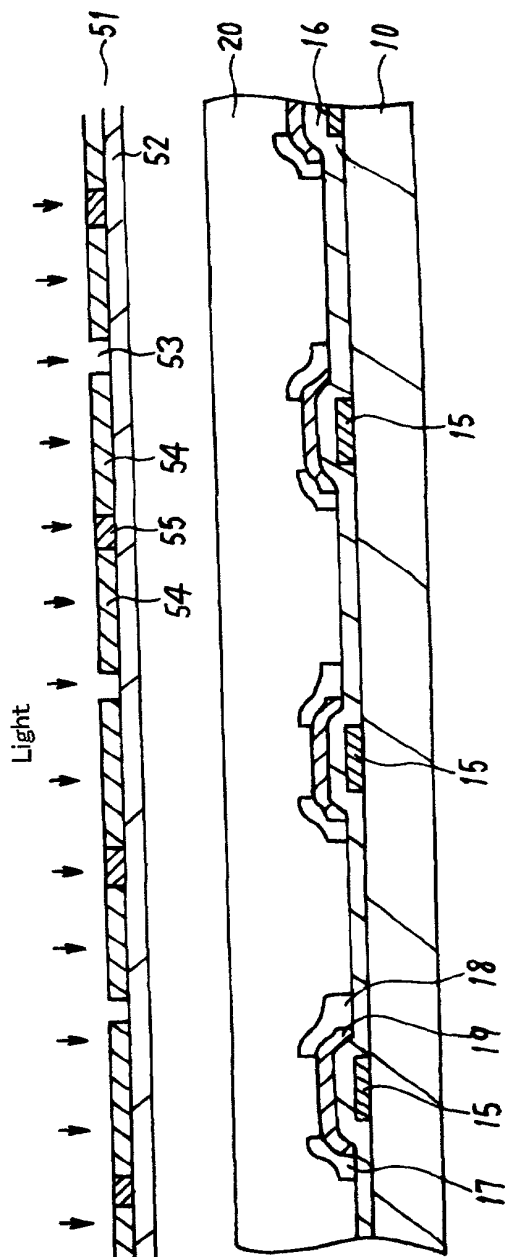


FIG. 17A

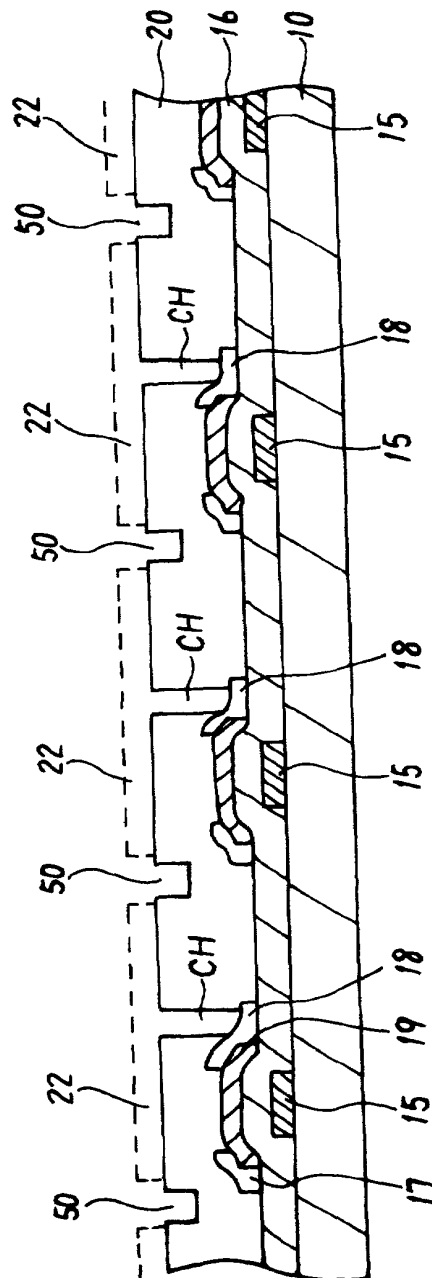
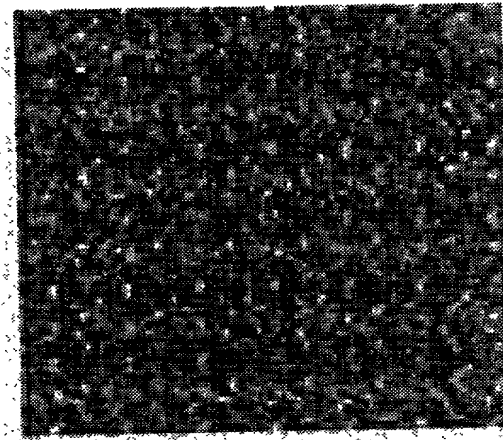


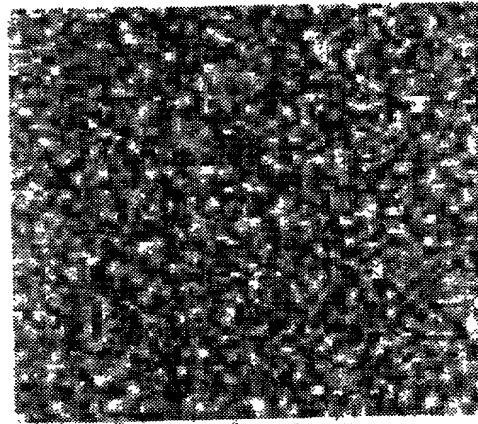
FIG. 17B

FIG. 18A



with separation line

FIG. 18B



without separation line

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FIG. 19

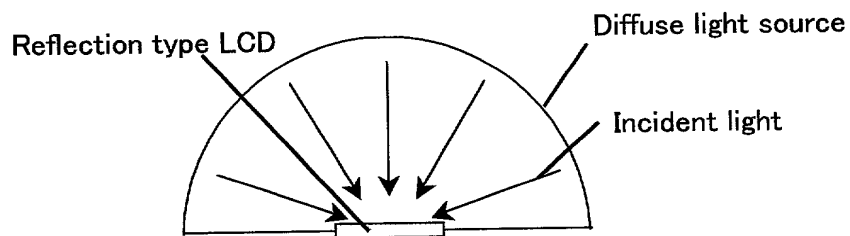
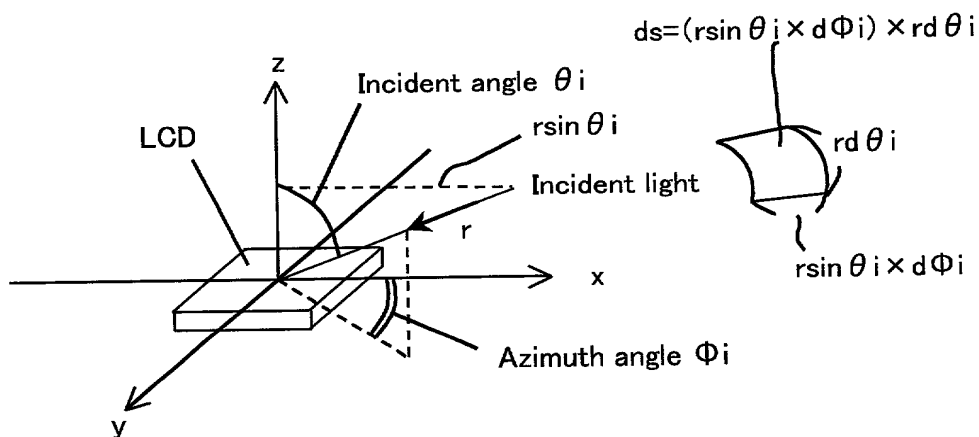


FIG. 20



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FIG. 21

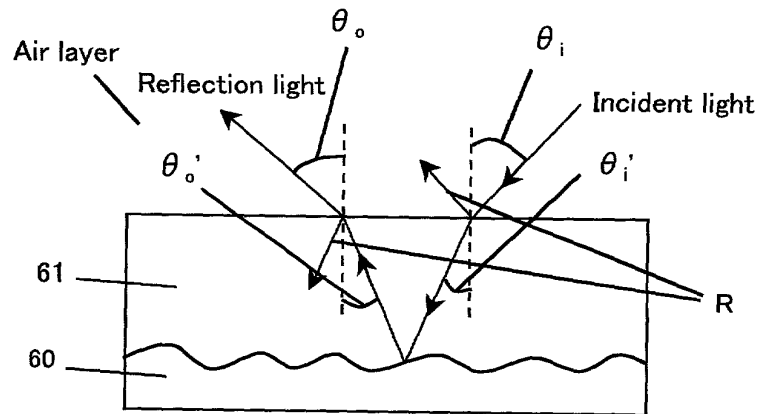


FIG. 22

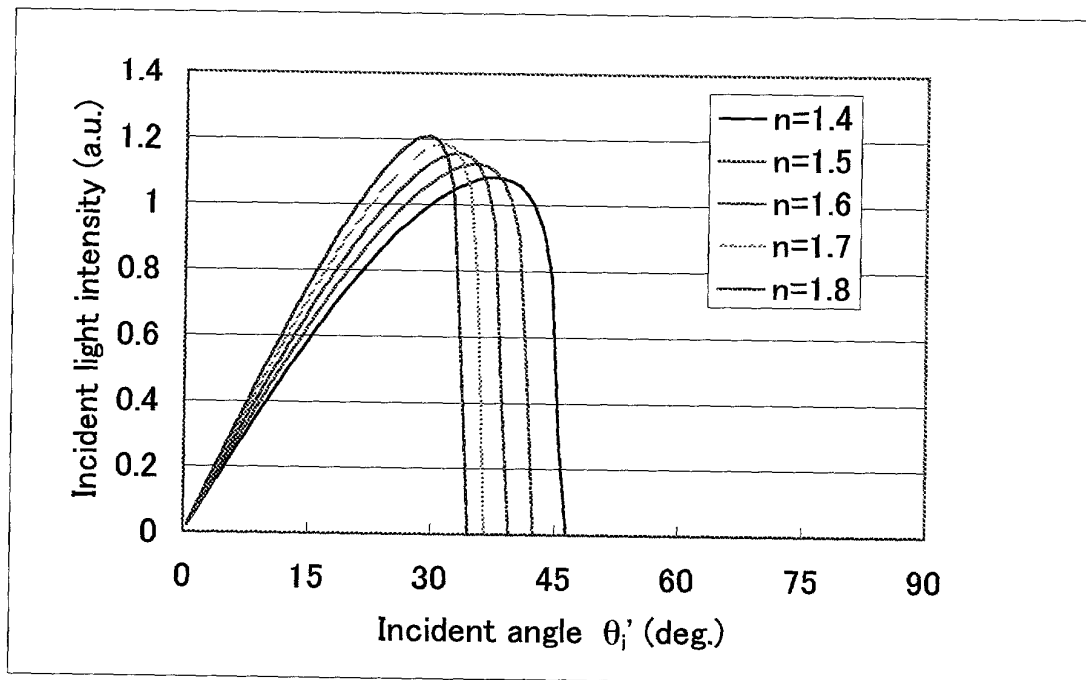


FIG. 23

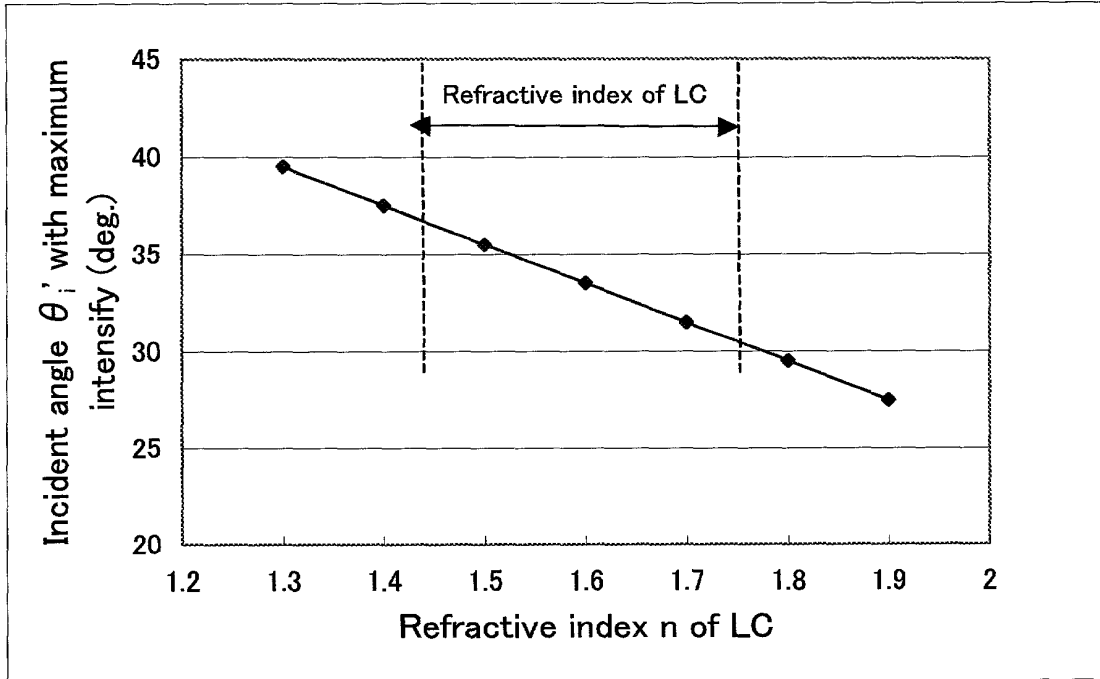


FIG. 24

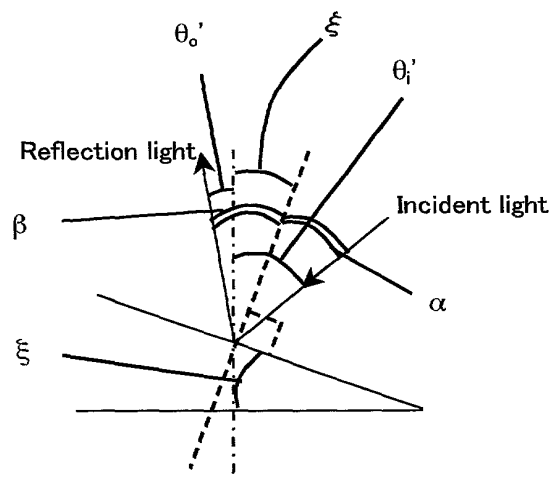


FIG. 25

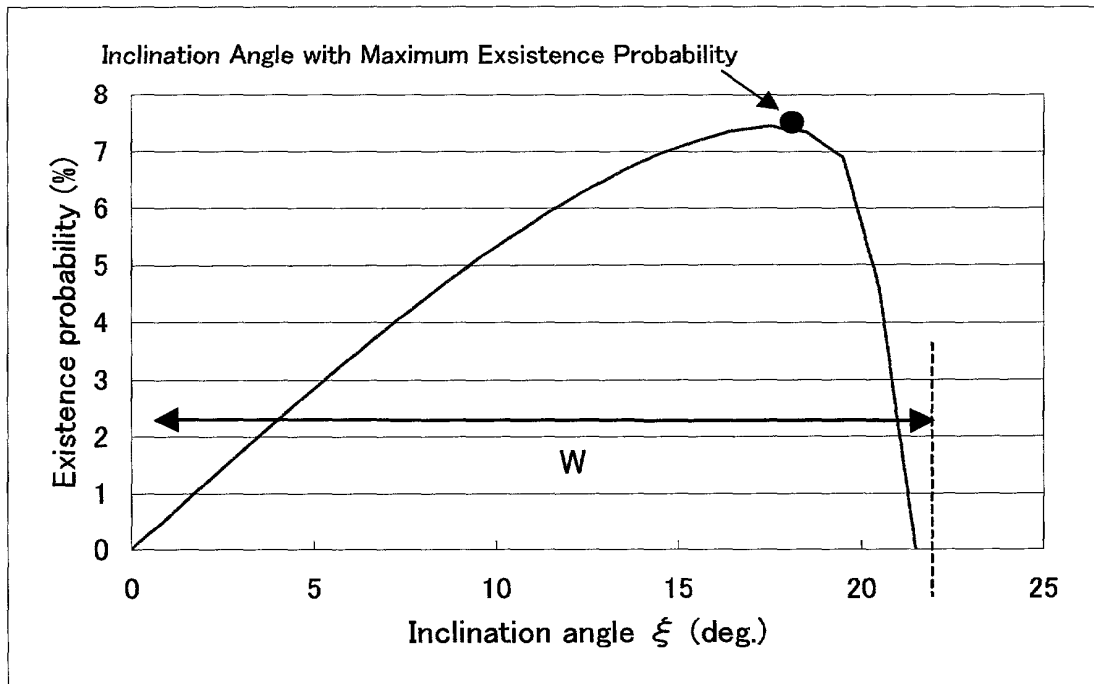


FIG. 26

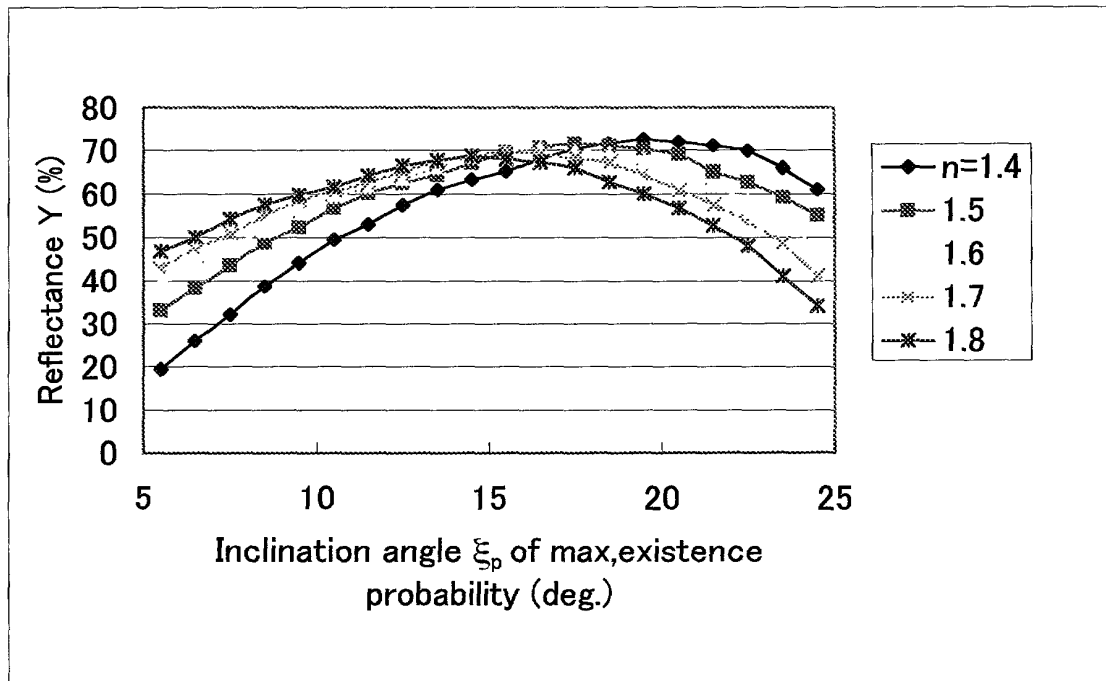
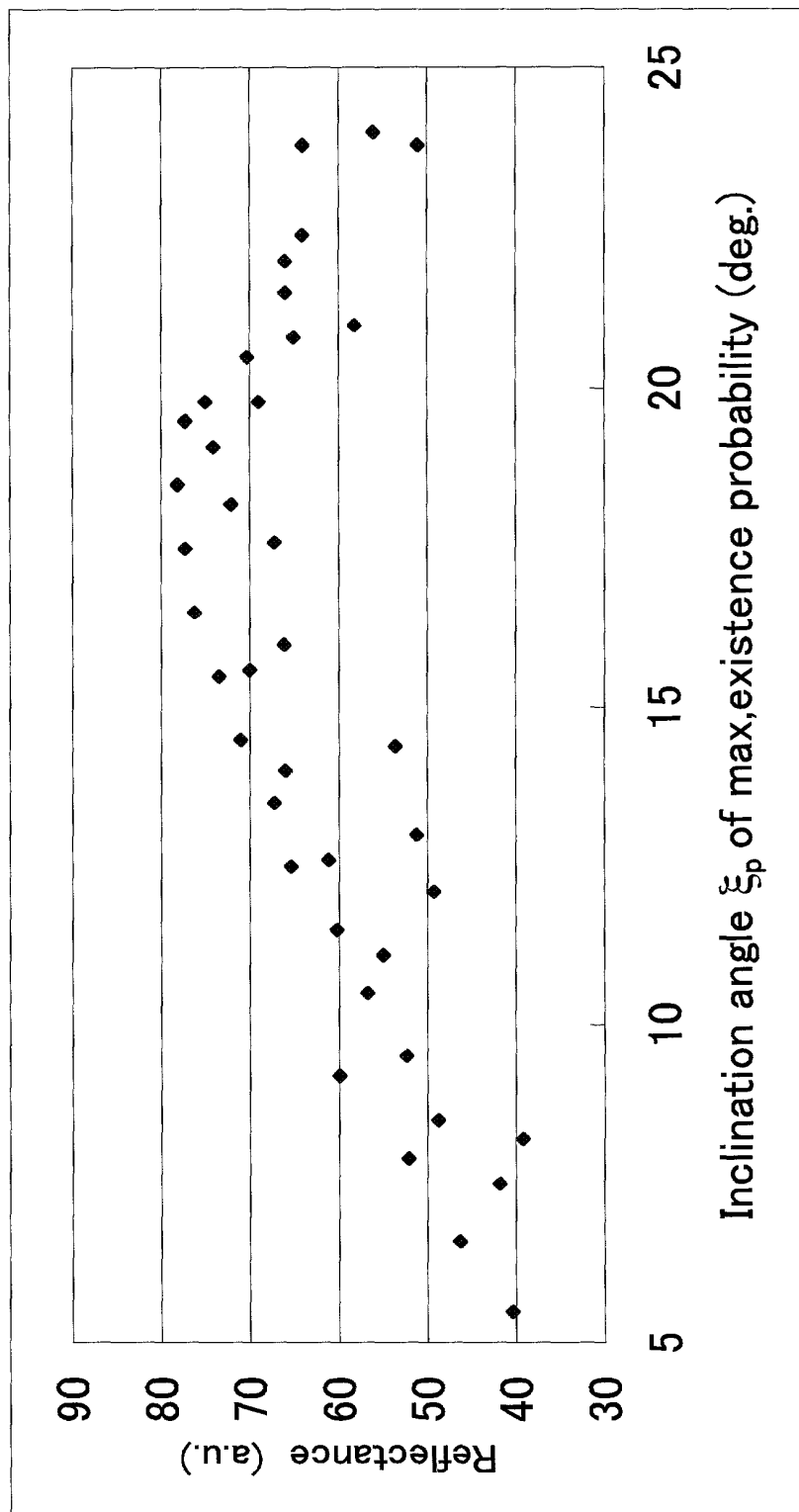
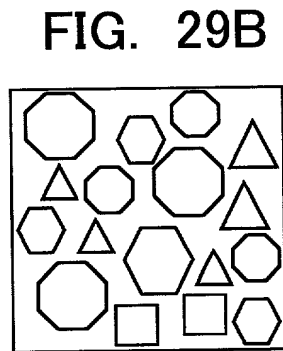
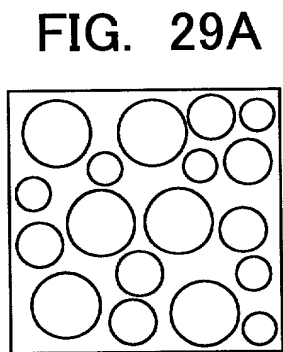
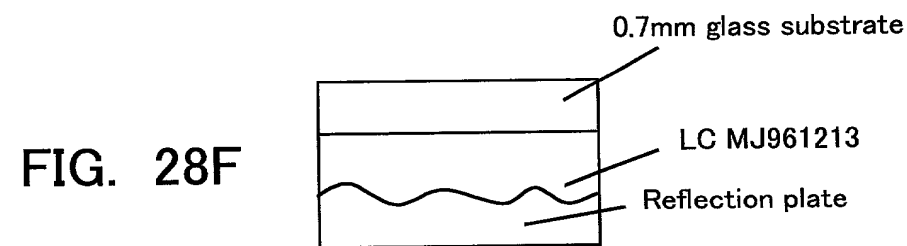
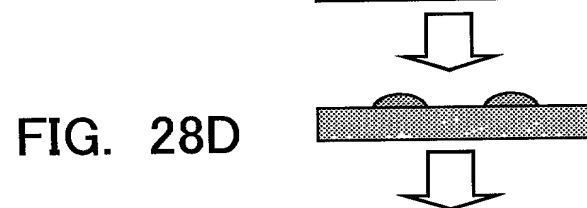
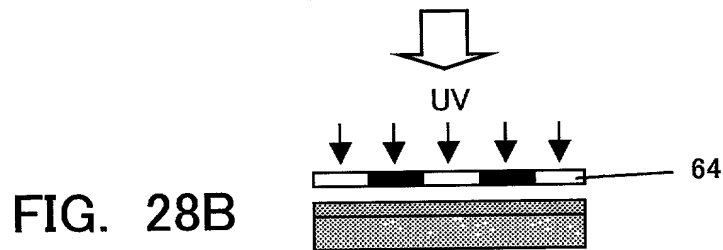
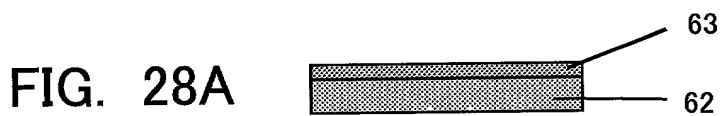


FIG. 27





Inclination angle (deg.)	Existence probability (%)
-21 ~ -	2.4
-18 ~ -	3.5
-18 ~ -	3.8
-18 ~ -	3.8
-15 ~ -	3.7
-15 ~ -	3.6
-15 ~ -	3.4
-12 ~ -	3.1
-12 ~ -	3.0
-12 ~ -	2.9
-9 ~ -8°	2.7
-9 ~ -8°	2.4
-9 ~ -8°	2.2
-6 ~ -5°	1.9
-6 ~ -5°	1.6
-6 ~ -5°	1.3
-3 ~ -2°	1.1
-3 ~ -2°	0.8
-3 ~ -2°	0.5
0 ~ 1°	0.2
0 ~ 1°	0.2
0 ~ 1°	0.5
3 ~ 4°	0.8
3 ~ 4°	1.1
3 ~ 4°	1.4
6 ~ 7°	1.7
6 ~ 7°	1.9
6 ~ 7°	2.2
9 ~ 10°	2.5
9 ~ 10°	2.7
9 ~ 10°	2.9
12 ~ 13°	3.1
12 ~ 13°	3.4
12 ~ 13°	3.5
15 ~ 16°	3.6
15 ~ 16°	3.8
15 ~ 16°	3.9
18 ~ 19°	3.8
18 ~ 19°	3.6
18 ~ 19°	2.5

The diagram illustrates the geometry of a tilted surface (70) and its projection onto a horizontal plane (70B). A coordinate system (x, y, z) is shown. The surface (70) is tilted at an angle β relative to the horizontal direction. The normal line is perpendicular to the surface. The angle between the normal line and the horizontal direction is $\alpha + \beta$. The angle between the surface and the horizontal direction is α . The angle between the normal line and the surface is -90° . The surface is labeled 70, 70A, and 70B.

FIG. 32

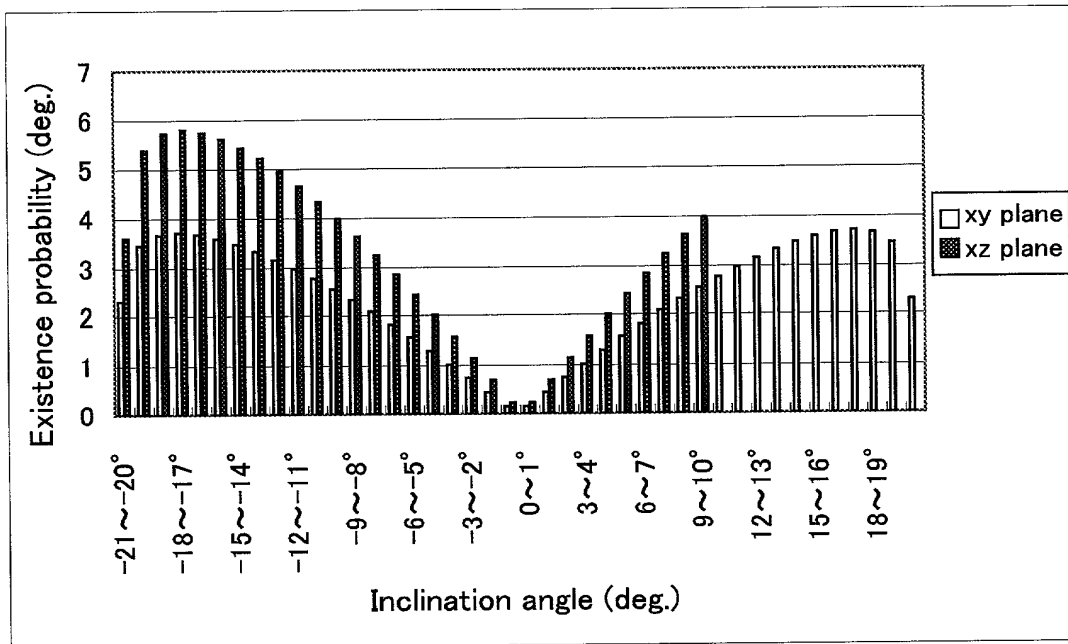
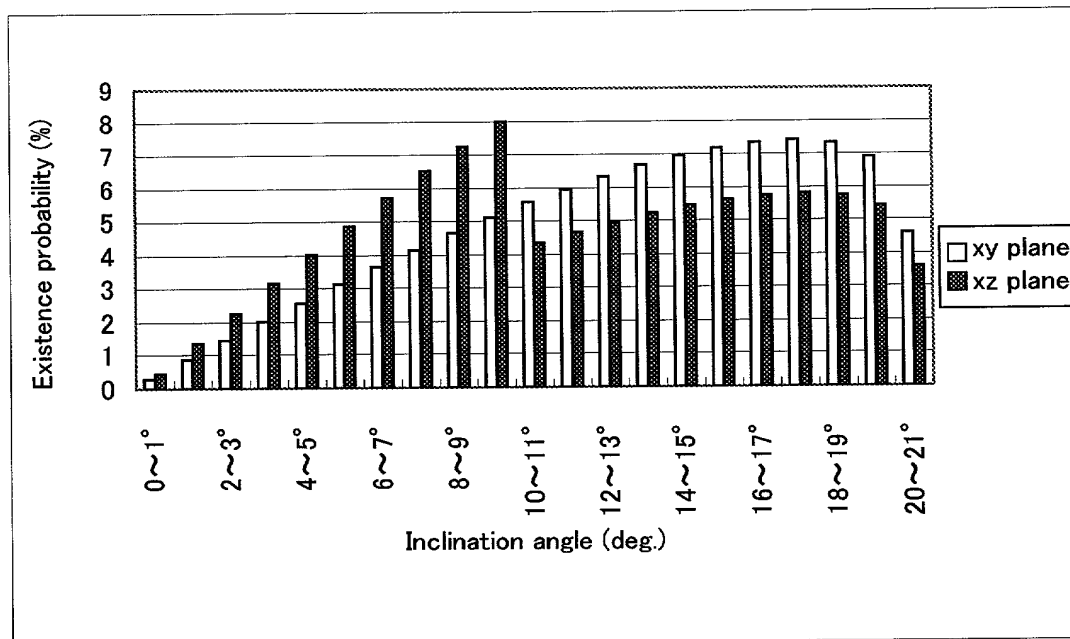


FIG. 33



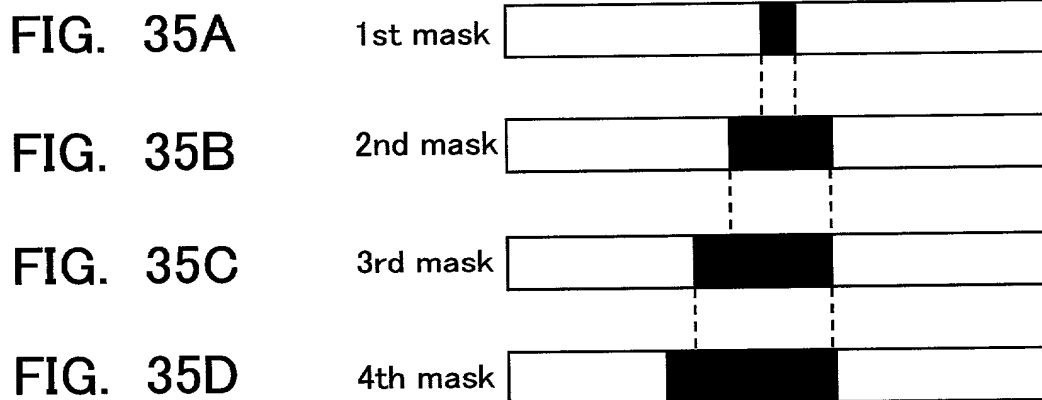
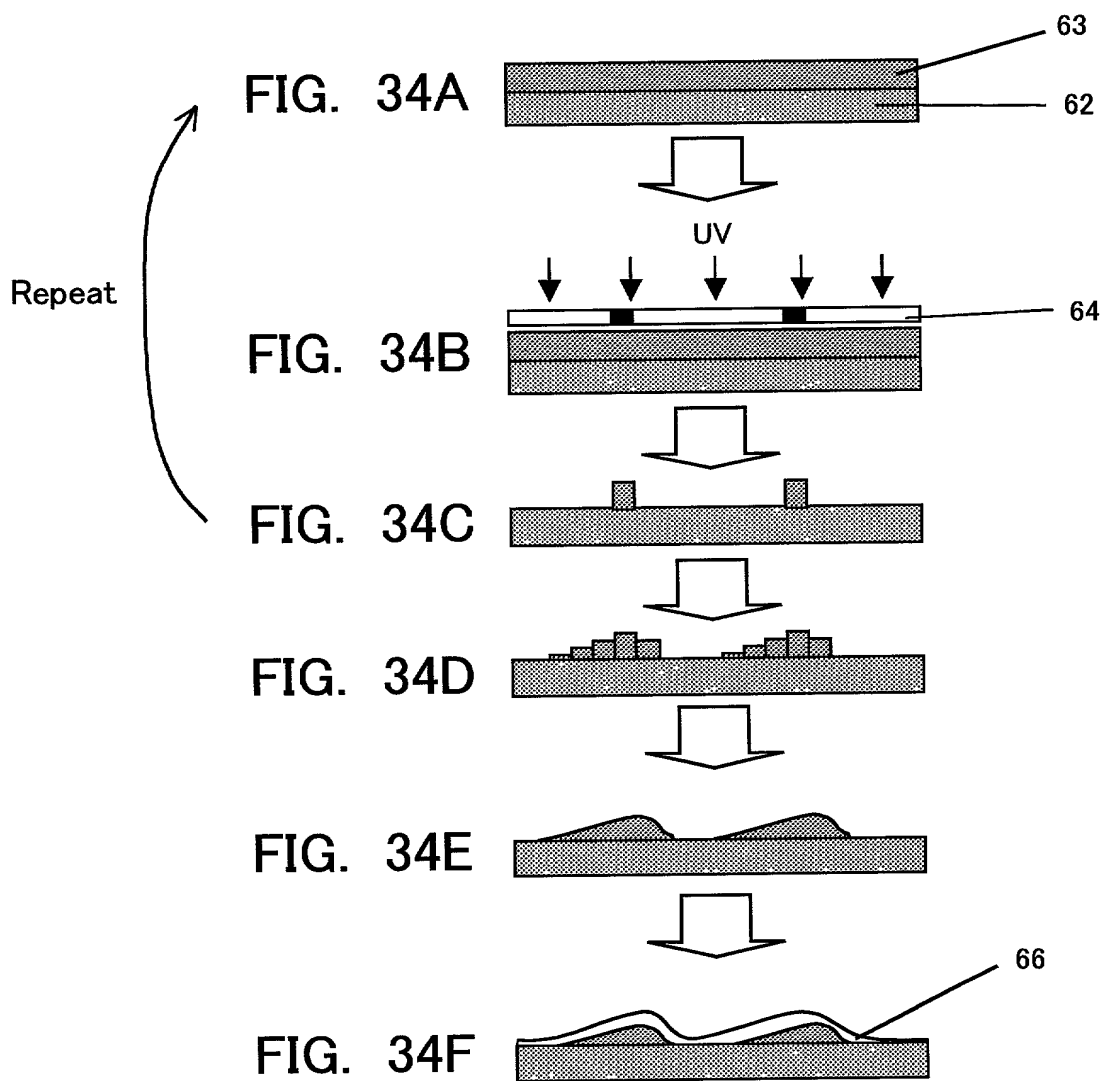


FIG. 36

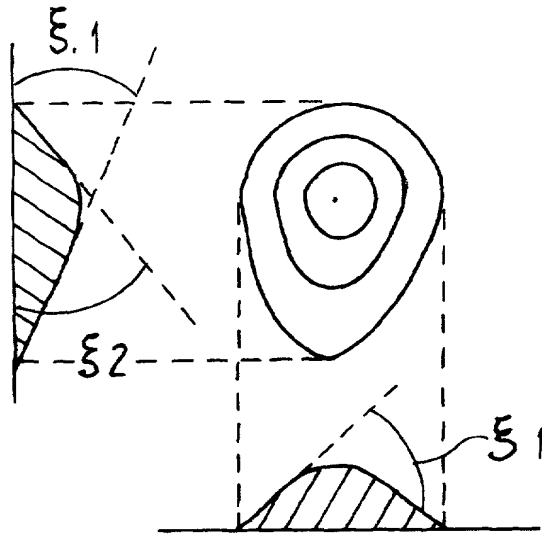


FIG. 37

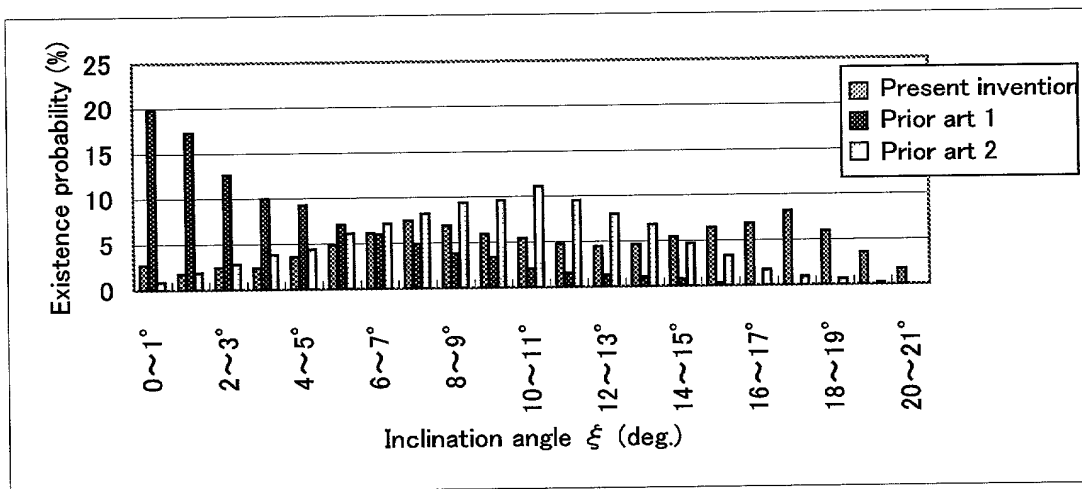


FIG. 38

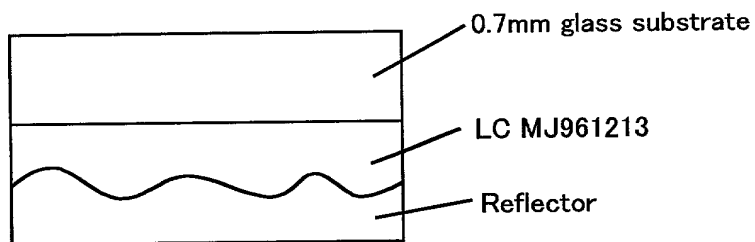


FIG. 39

Measurement result of reflectance

	Present invention	Prior art 1	Prior art 2
Reflectance	61%	31%	53%

Present invention : Existence probability of indication angle is maximum at 8° - 18°
 Prior art 1 : Existence probability of indication angle is maximum at only 0°
 Prior art 2 : Existence probability of indication angle is maximum at only 10°

FIG. 40

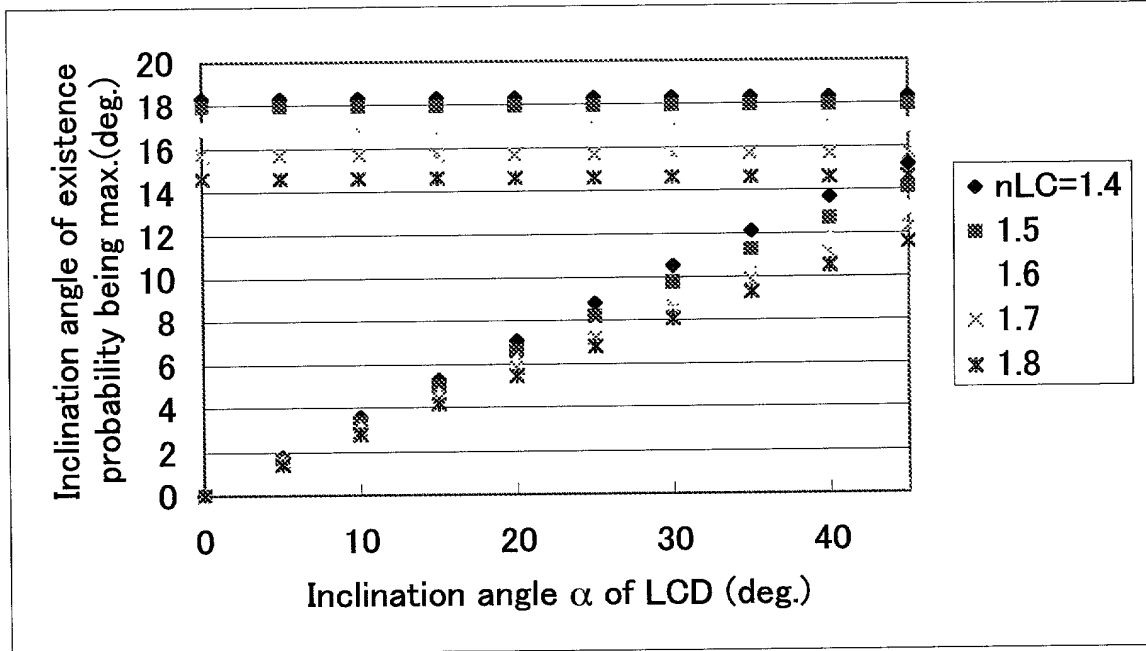


FIG. 41

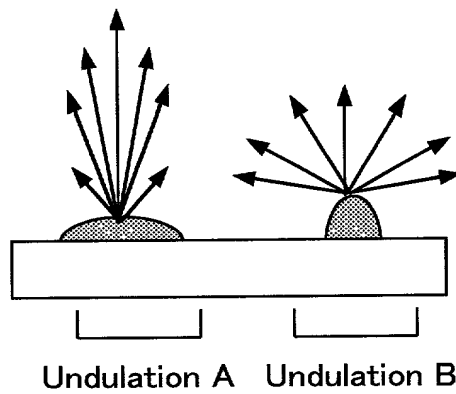
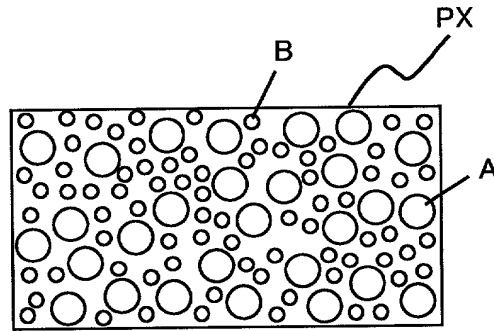


FIG. 42



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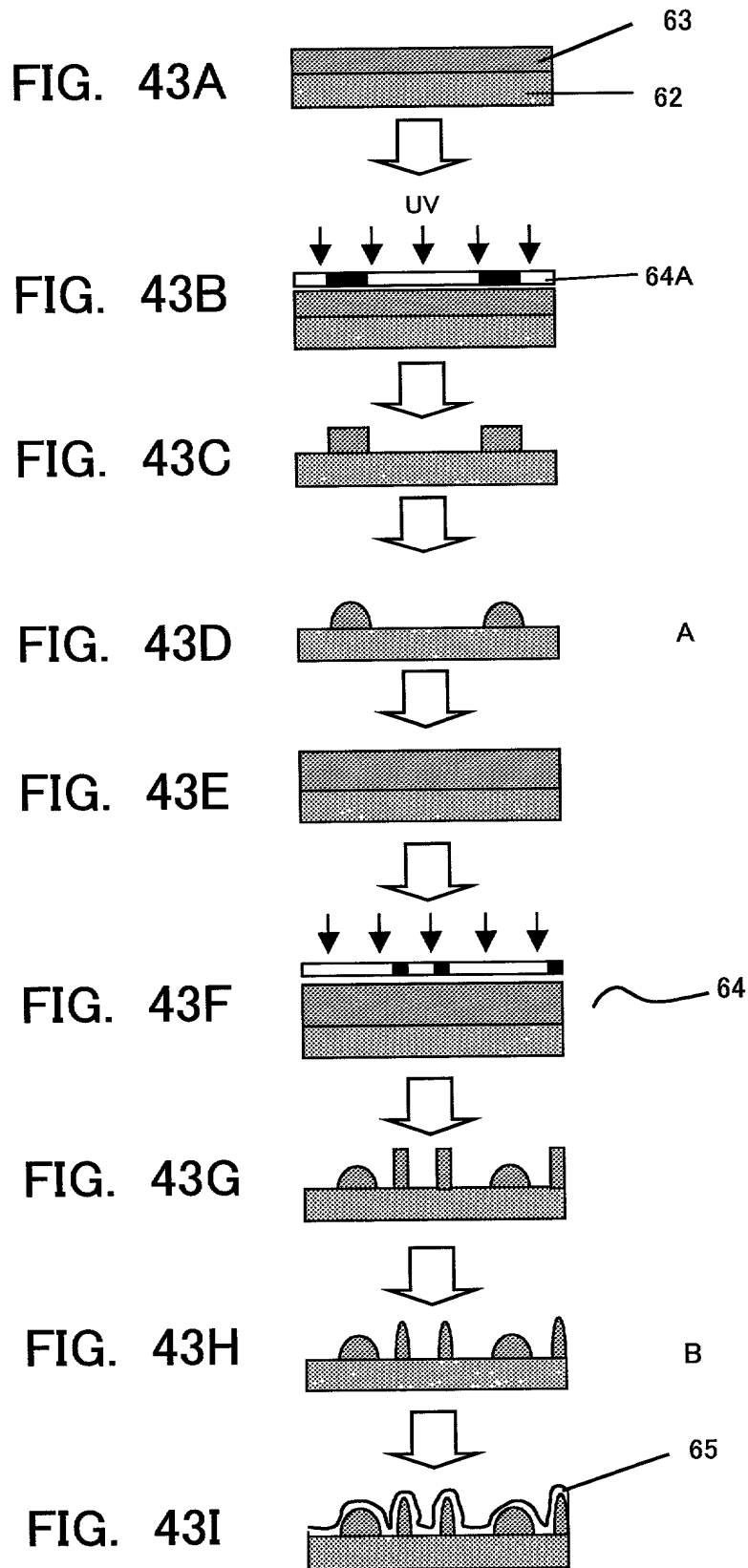
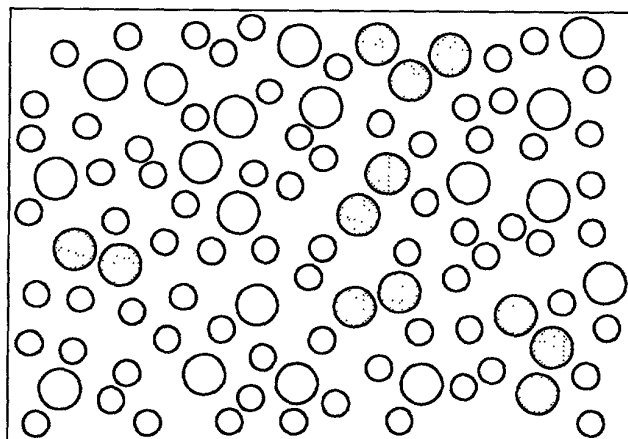
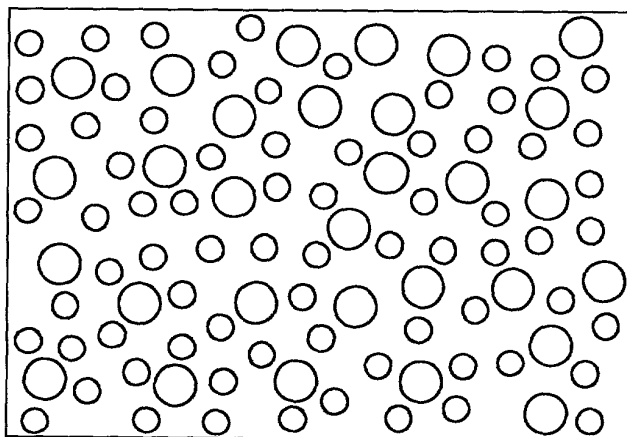


FIG. 44



Unite image

FIG. 45



Unite image

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FIG. 46A

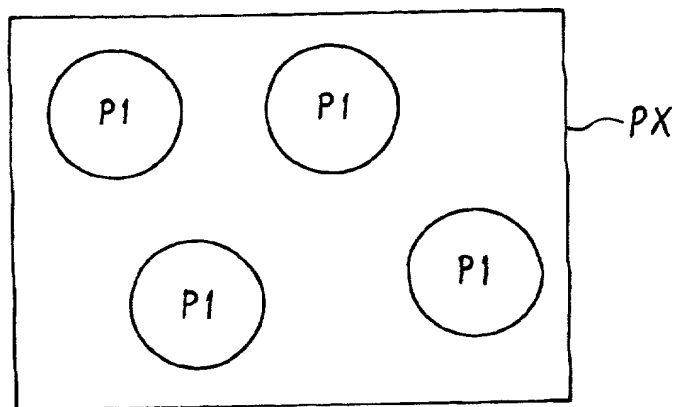


FIG. 46B

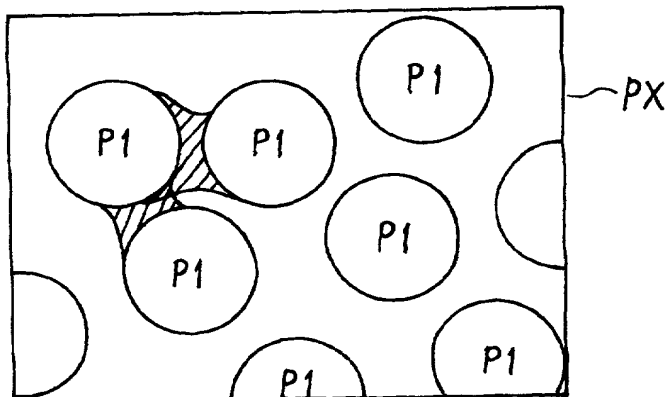
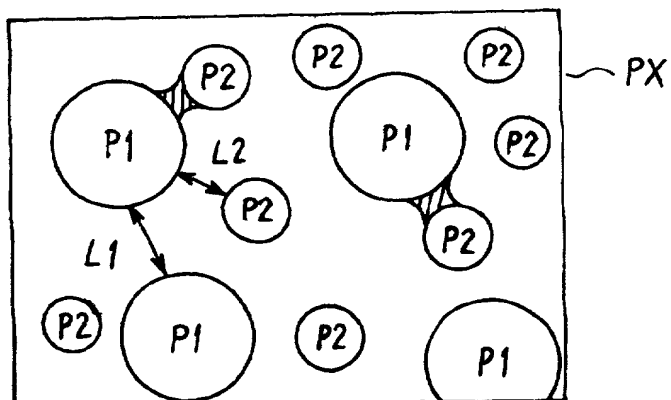


FIG. 46C



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FIG. 47

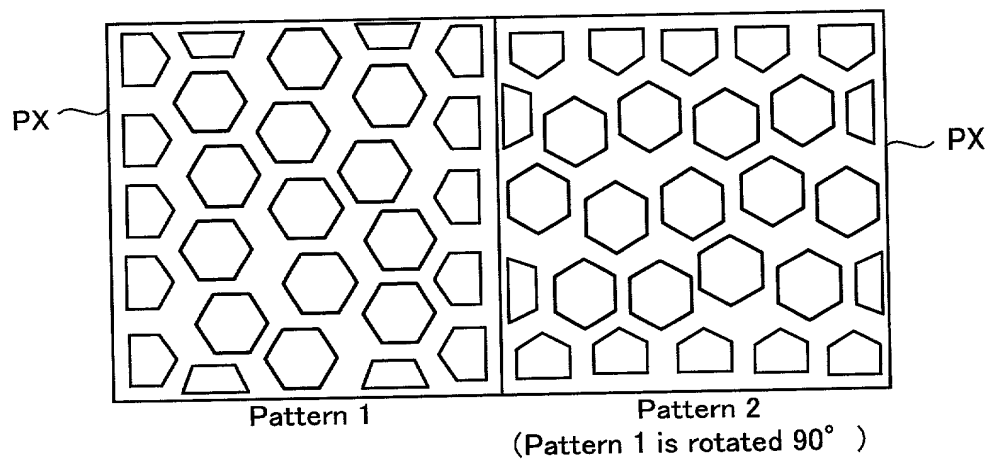


FIG. 48

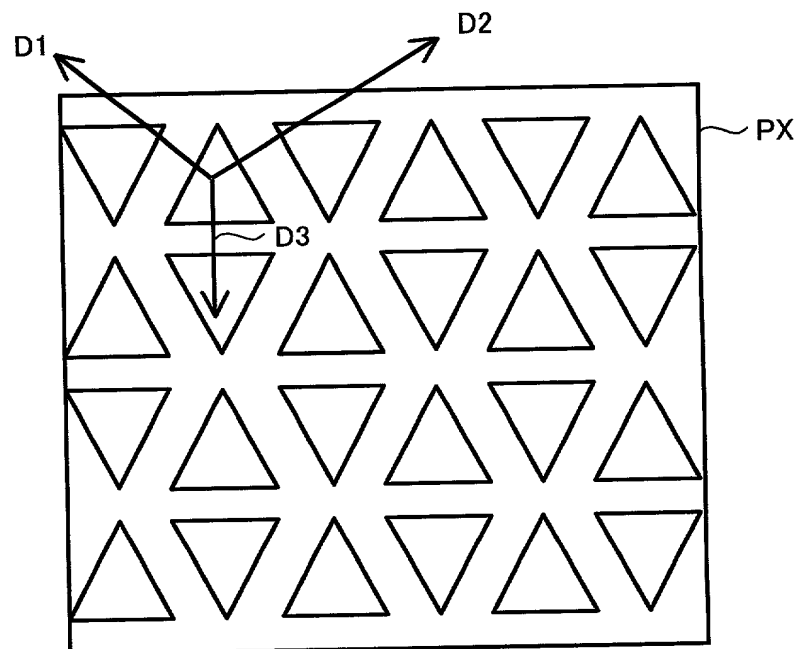
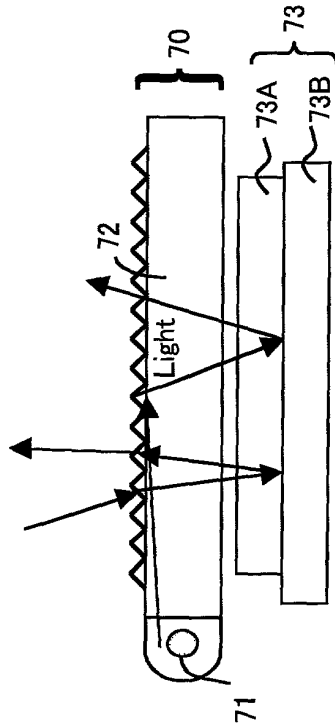


FIG.49

Prior Art



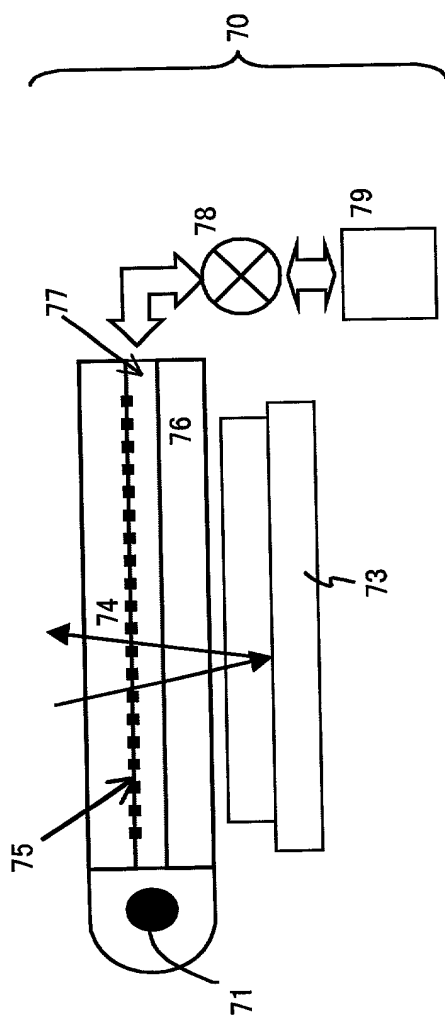


FIG. 50A
 At bright place

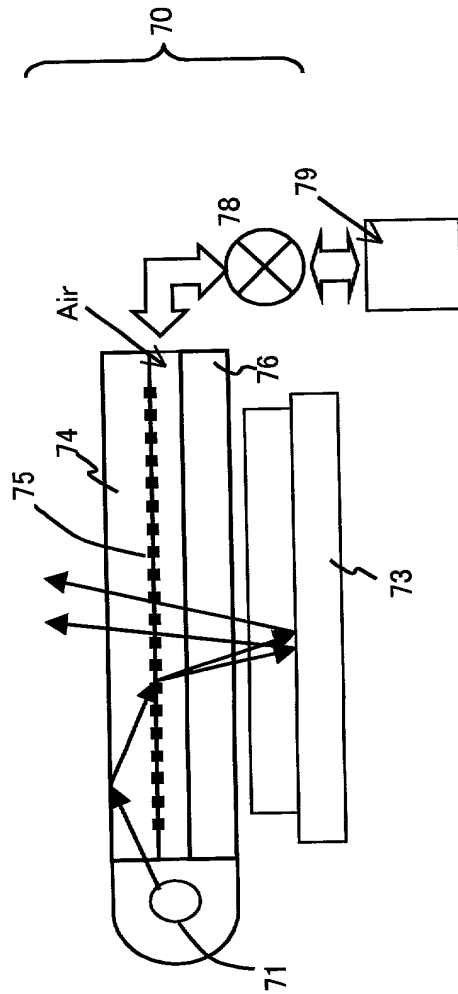


FIG. 50B
 At dark place

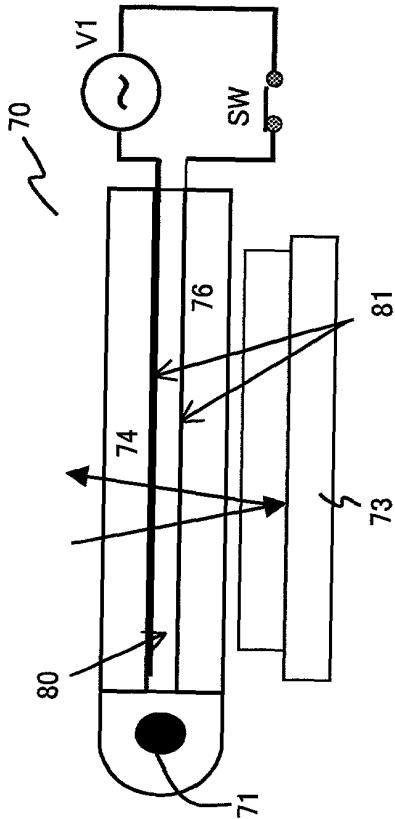


FIG. 51A
At bright place

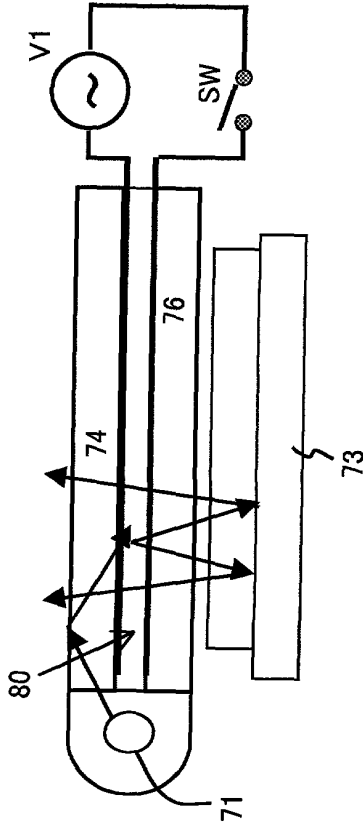


FIG. 51B
At dark place

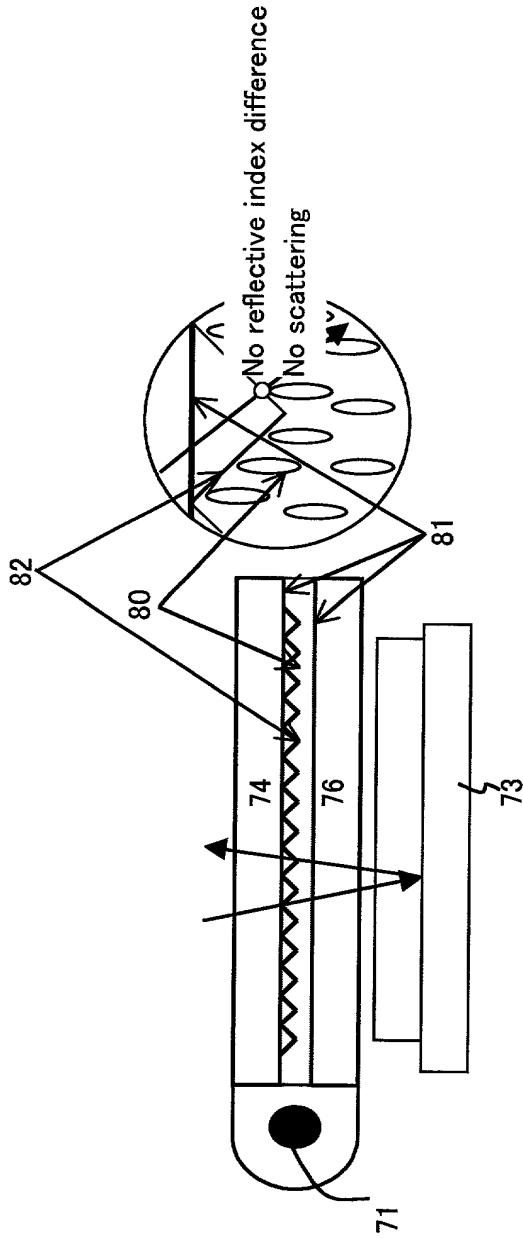


FIG. 52A

At bright place

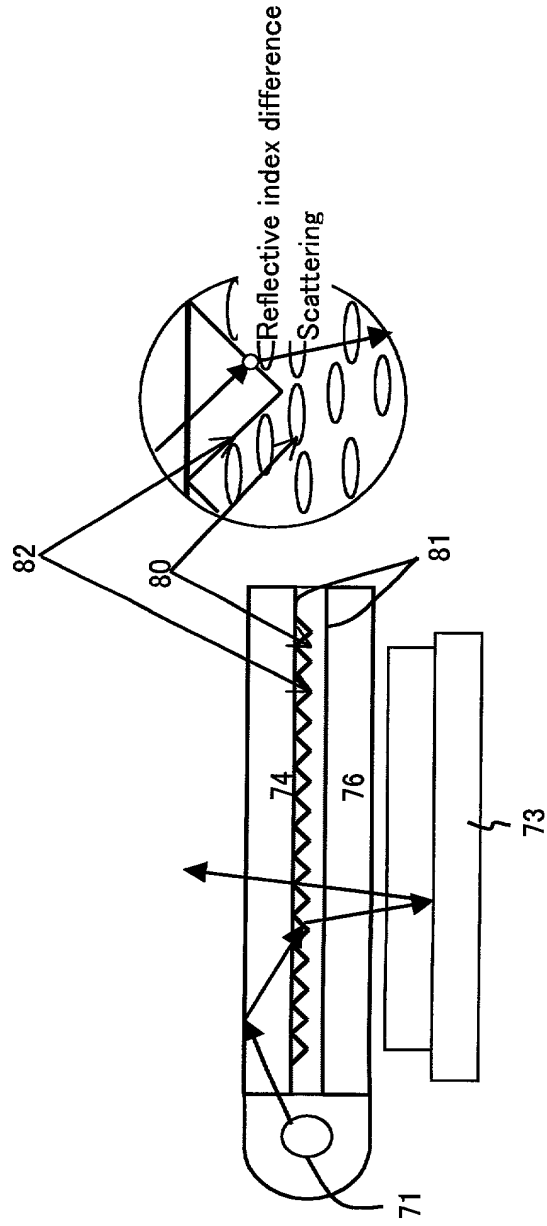


FIG. 52B

At dark place

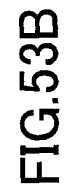
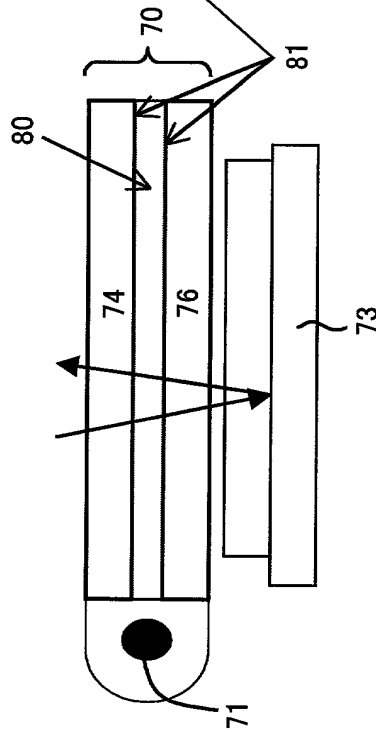


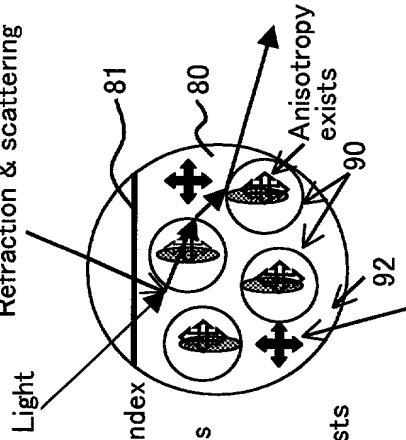
FIG.54A

At bright place

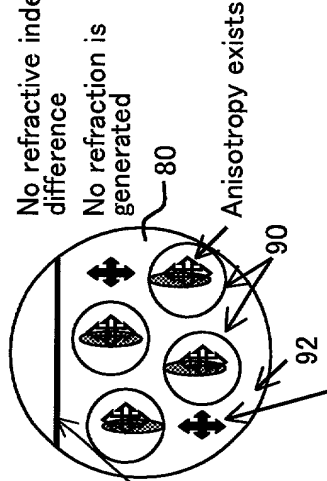


Liquid crystal A

Refractive index difference
in horizontal direction
Refraction & scattering



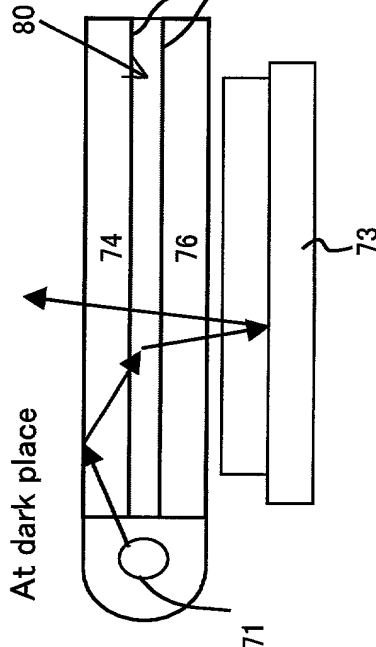
Liquid crystal B



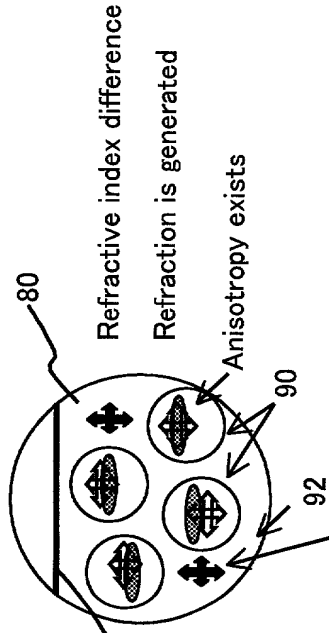
Anisotropy exists in polymer

FIG.54B

At dark place



Refractive index difference
Refraction is generated



Anisotropy exists in polymer

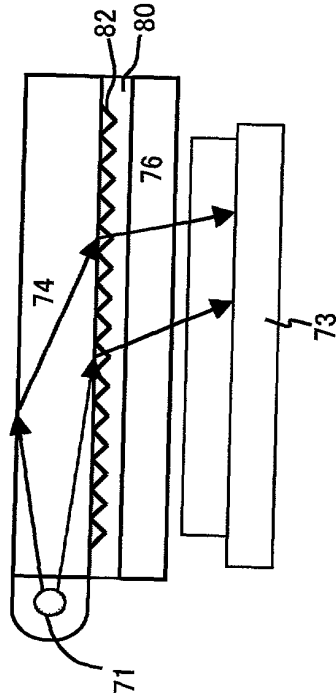


FIG. 55

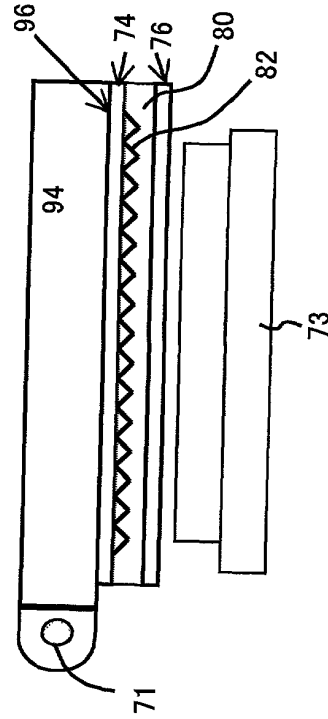


FIG. 56

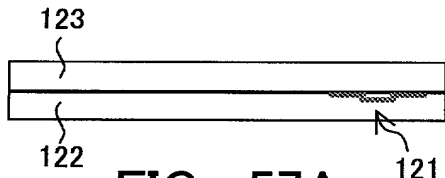


FIG. 57A

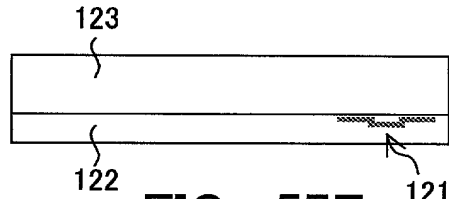


FIG. 57F

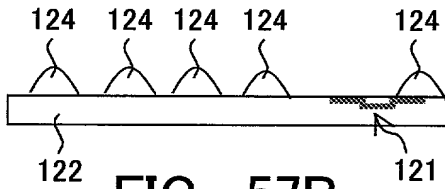


FIG. 57B

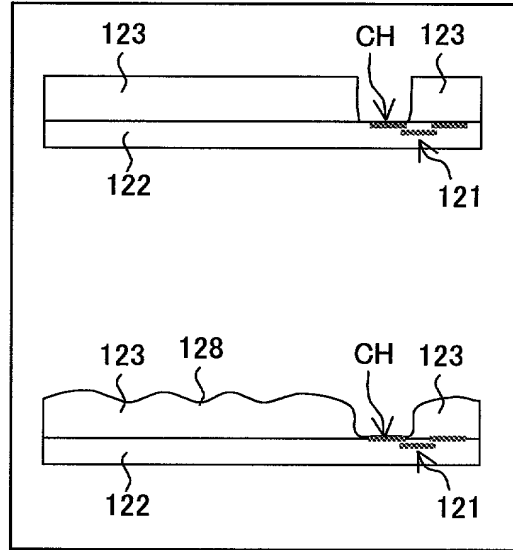


FIG. 57G

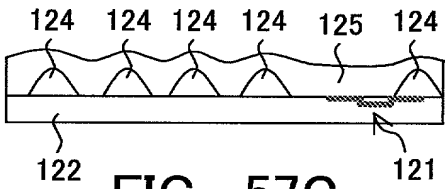


FIG. 57C

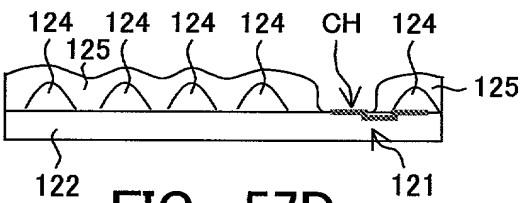


FIG. 57D

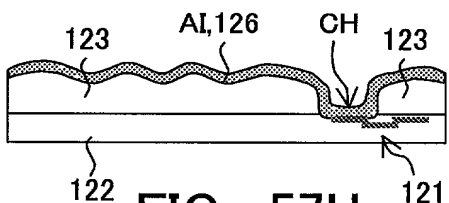


FIG. 57H

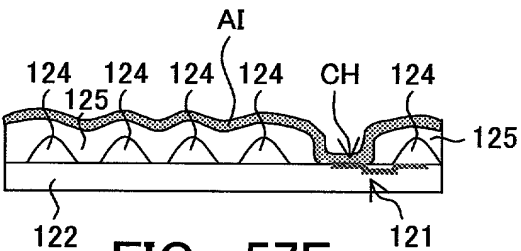
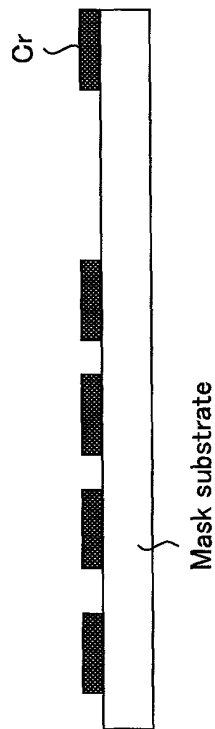


FIG. 57E

1st Exposure mask for half exposure



2nd Exposure mask for CH

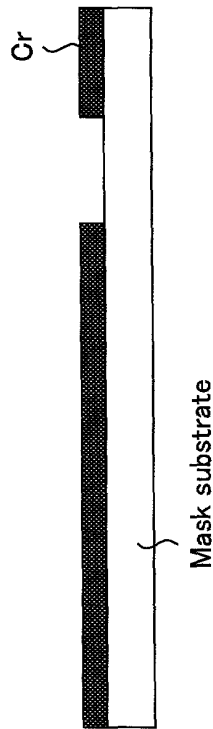


FIG. 58A

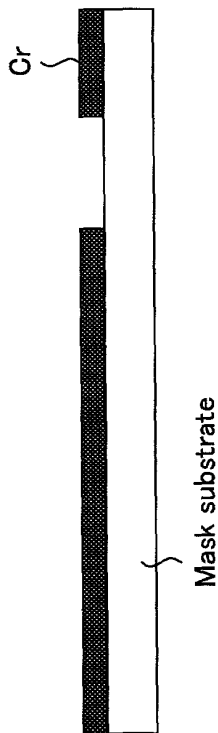


FIG. 58B

FIG. 59

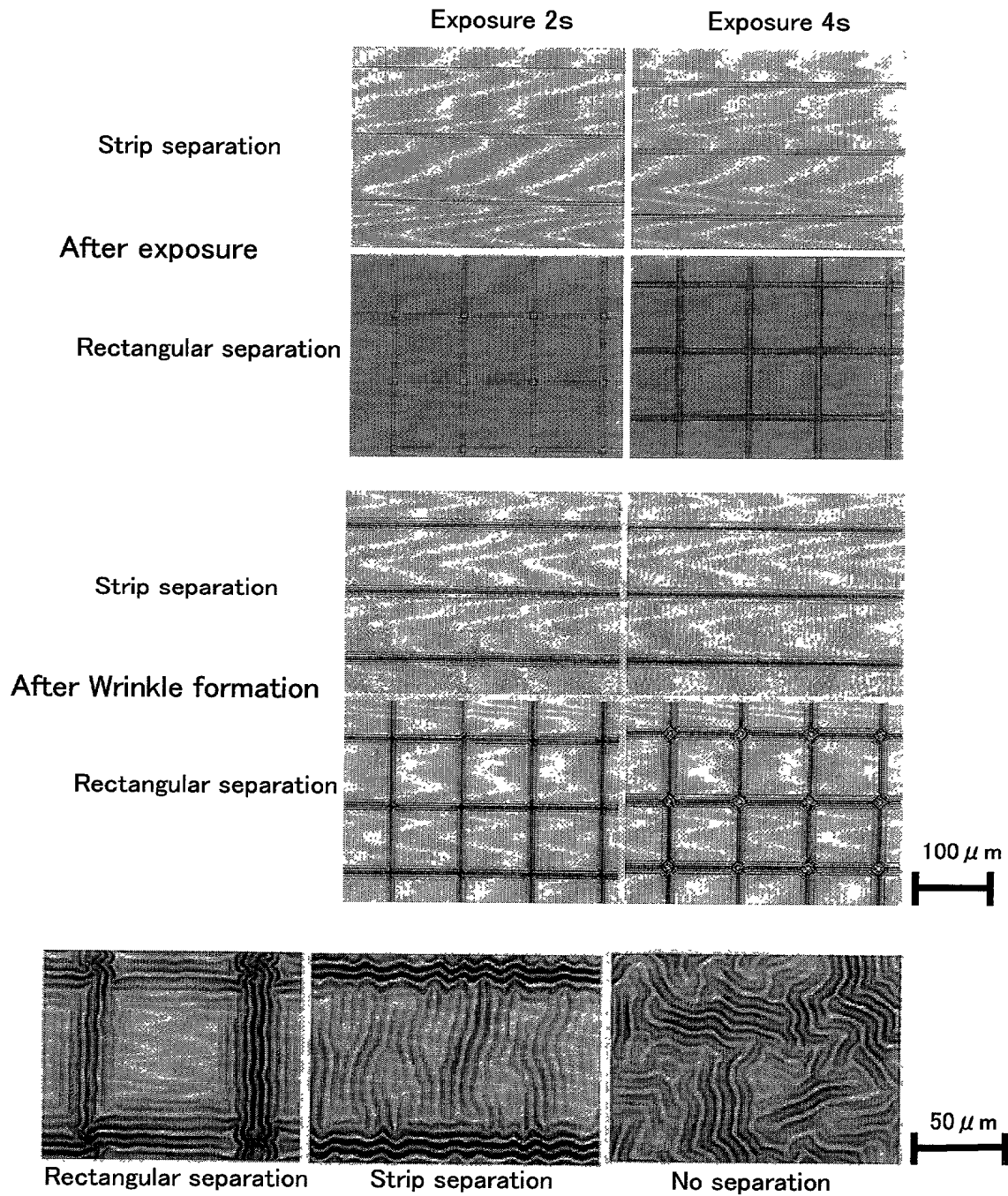


FIG. 60

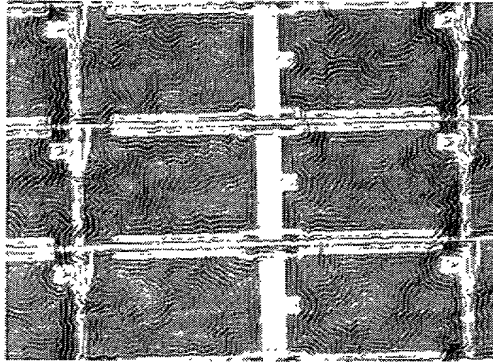
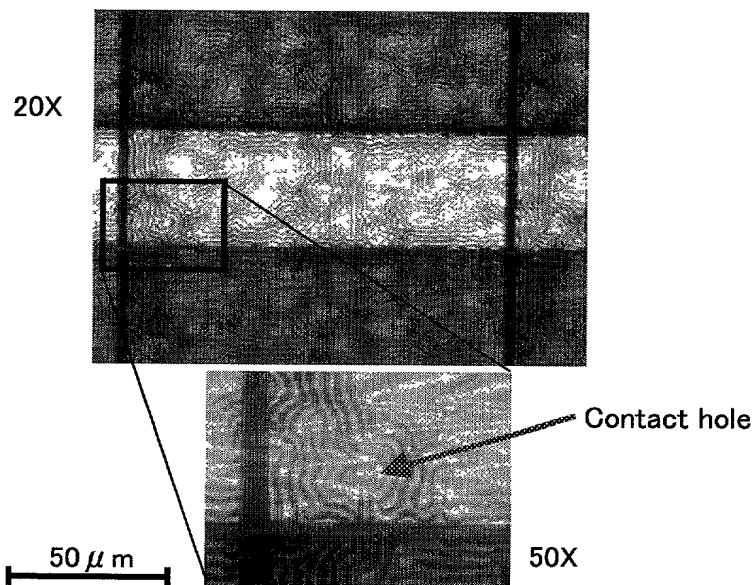


FIG. 61



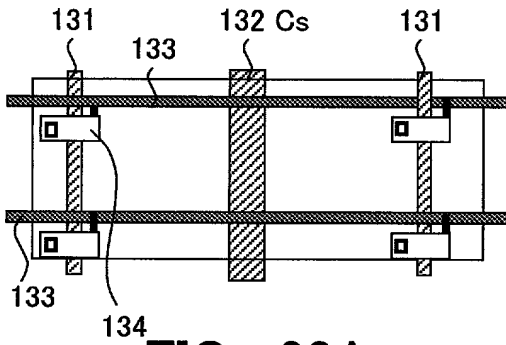


FIG. 62A

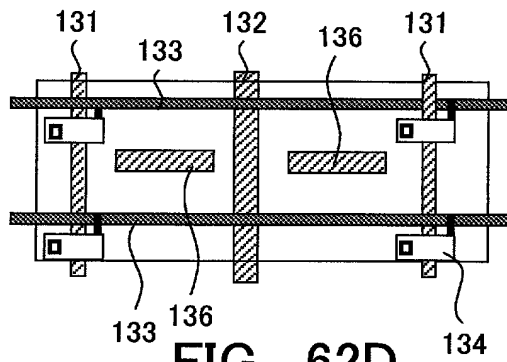


FIG. 62D

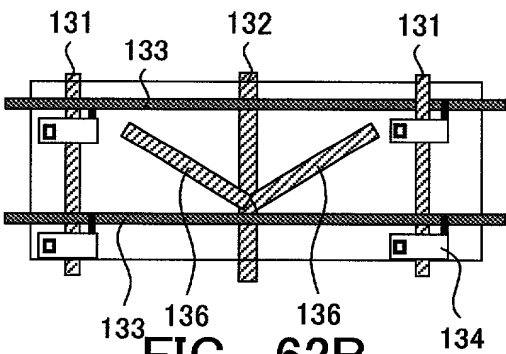


FIG. 62B

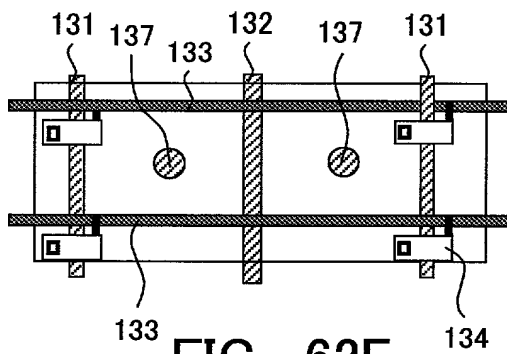


FIG. 62E

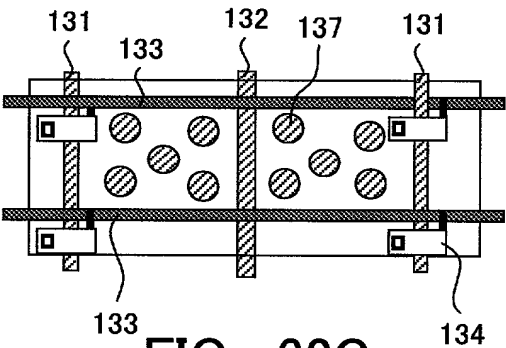


FIG. 62C

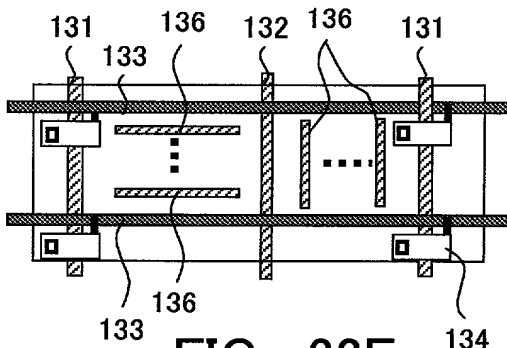


FIG. 62F

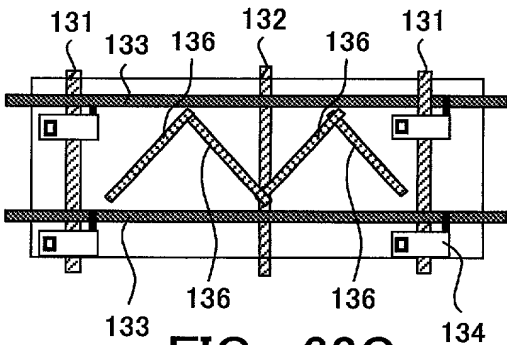


FIG. 62G

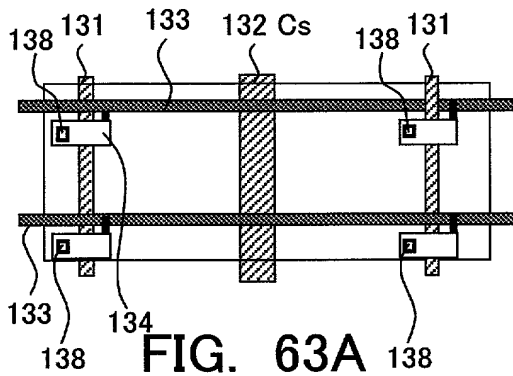


FIG. 63A

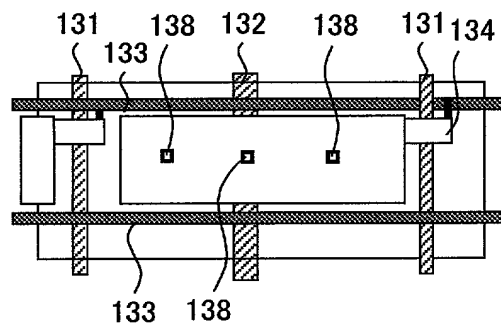


FIG. 63E

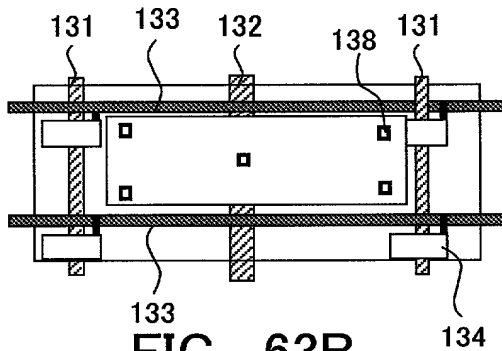


FIG. 63B

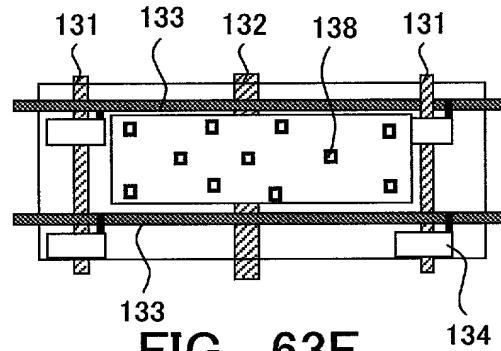


FIG. 63F

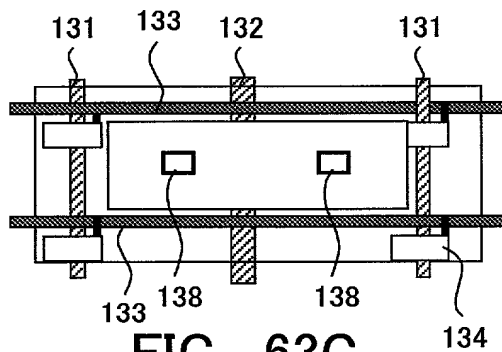


FIG. 63C

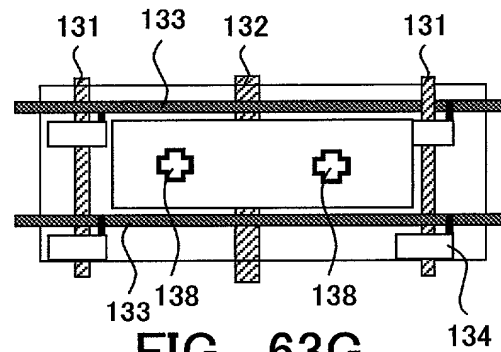


FIG. 63G

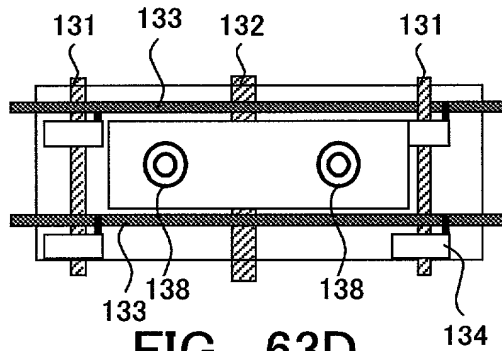


FIG. 63D

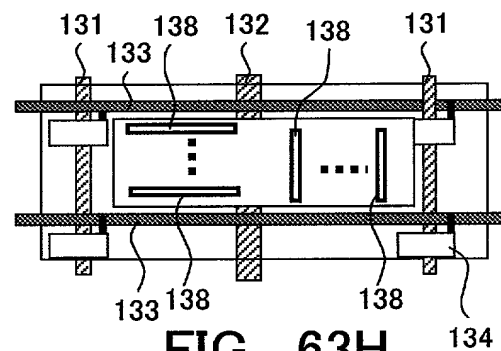


FIG. 63H

FIG. 64

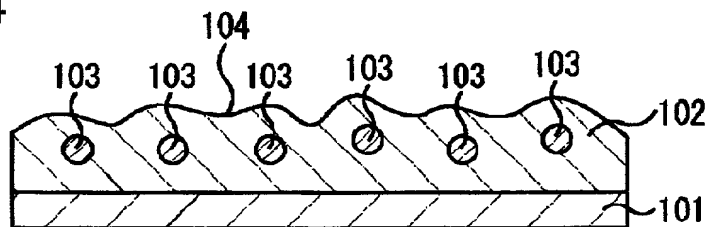


FIG. 65

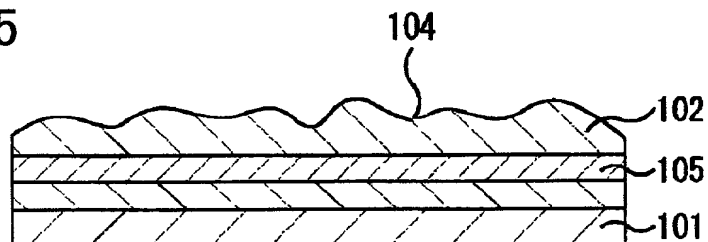


FIG. 66

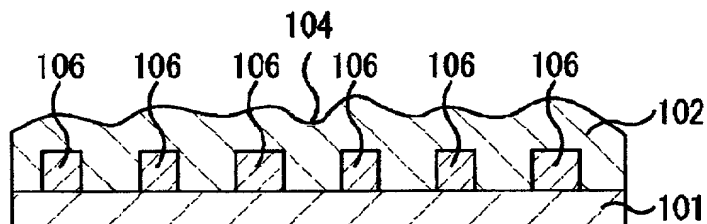
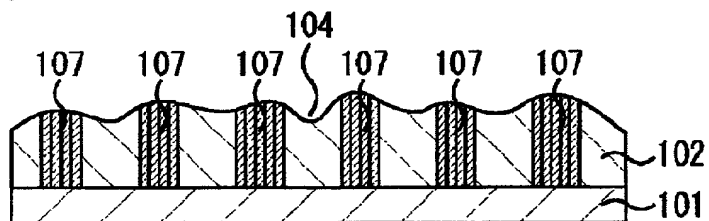


FIG. 67



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FIG. 68

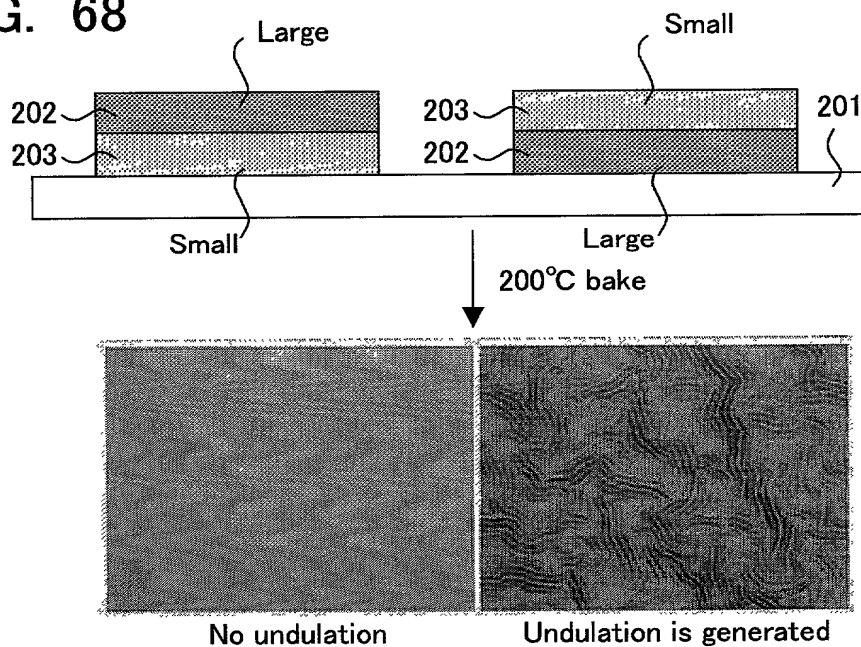


FIG. 69

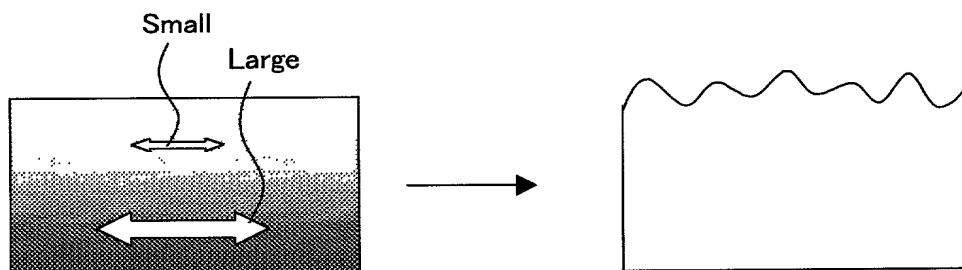


FIG. 70

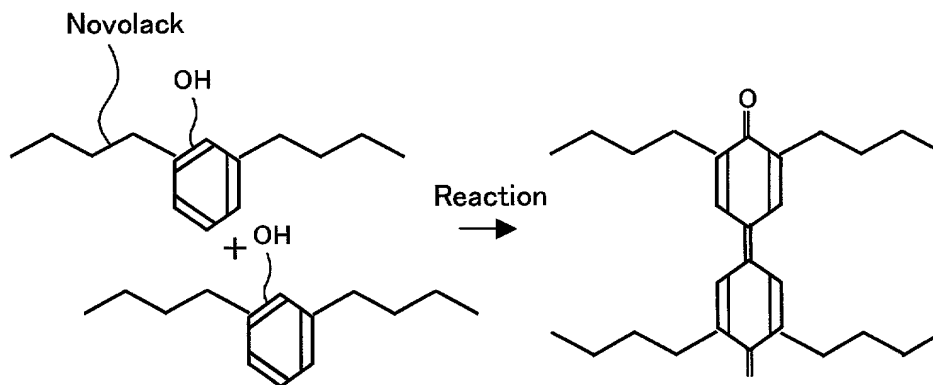
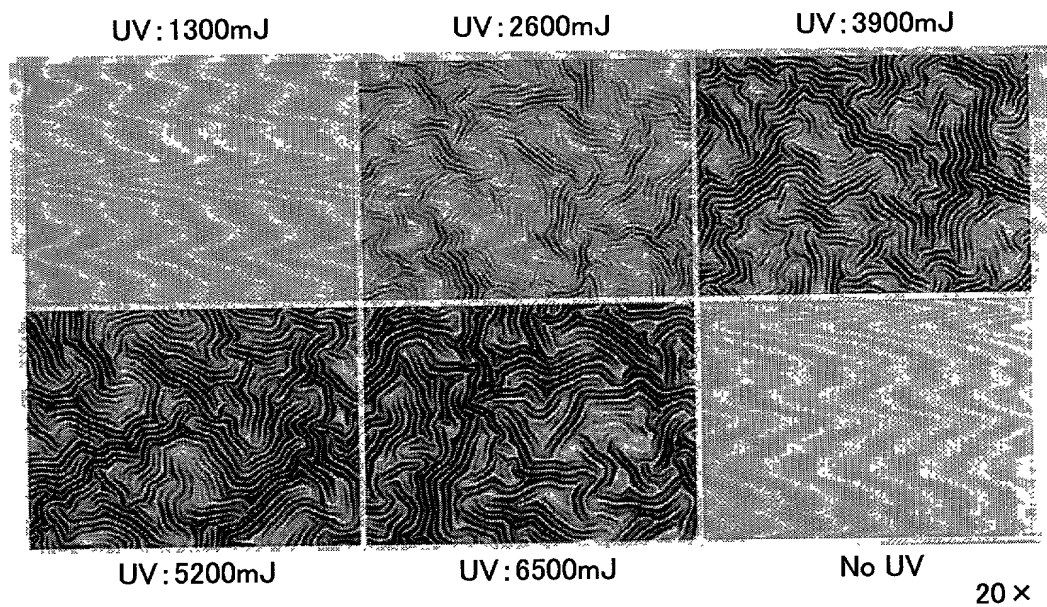


FIG. 71



203770" 50475001

FIG. 72

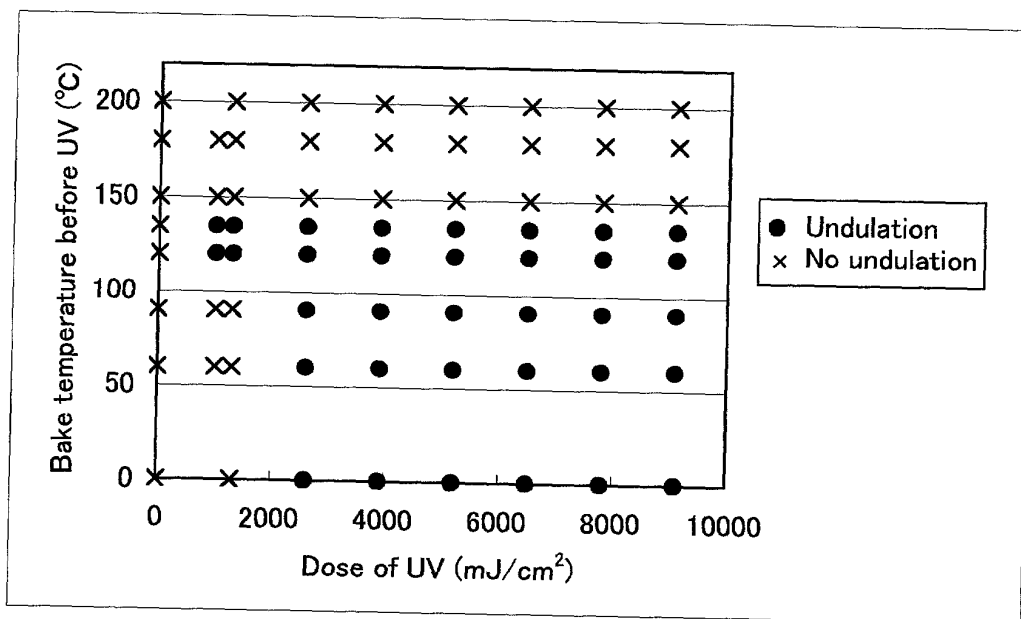


FIG. 73

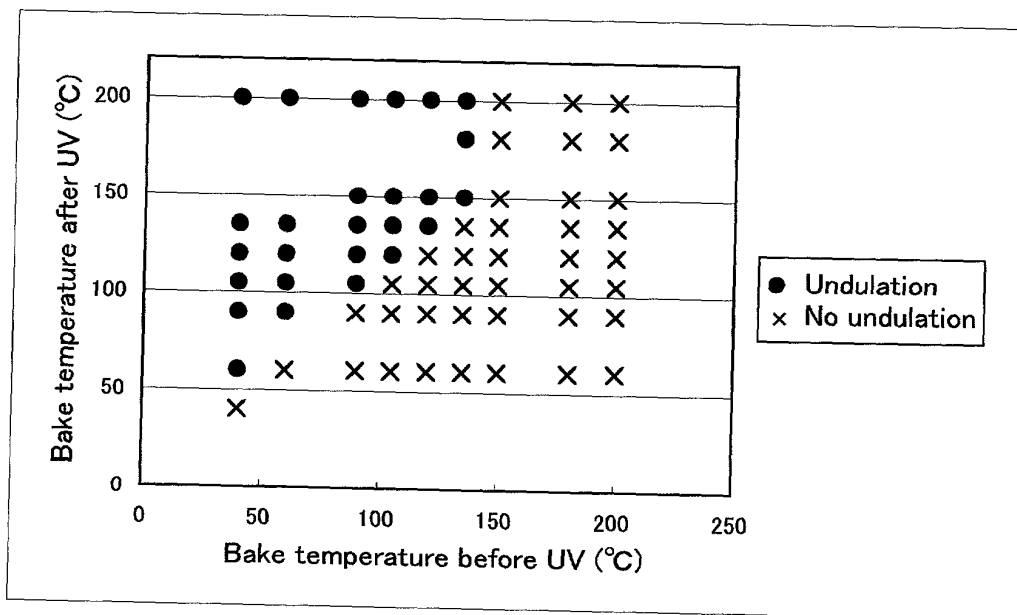


FIG. 74

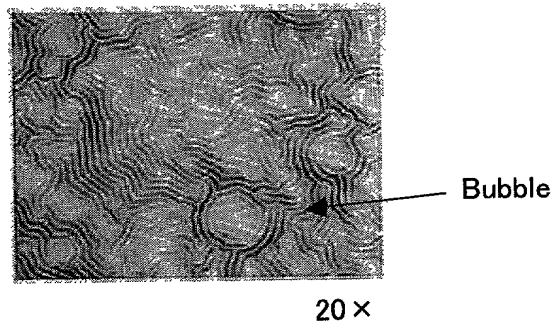


FIG. 75

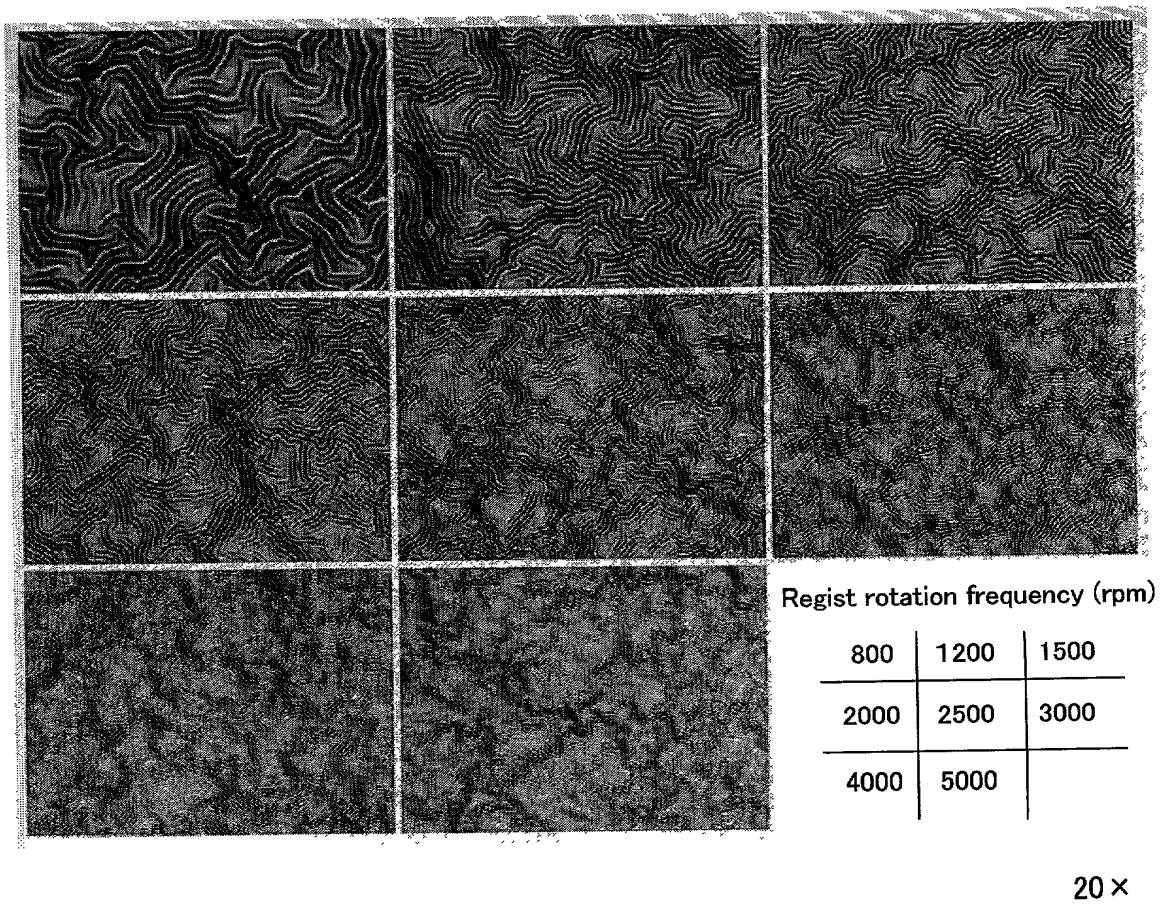


FIG. 76

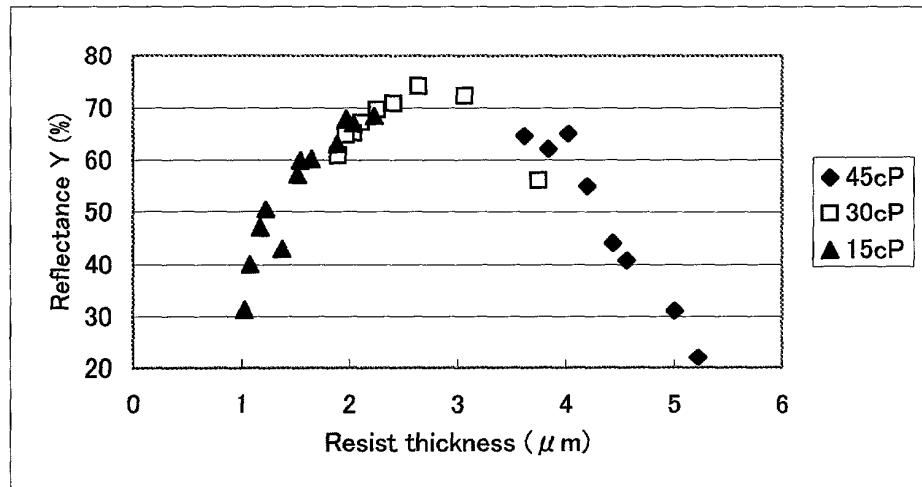


FIG. 77

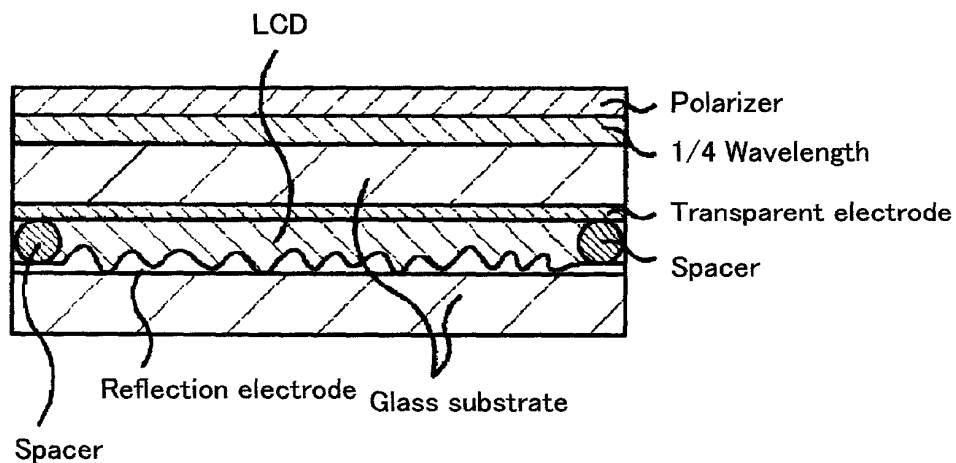


FIG. 78

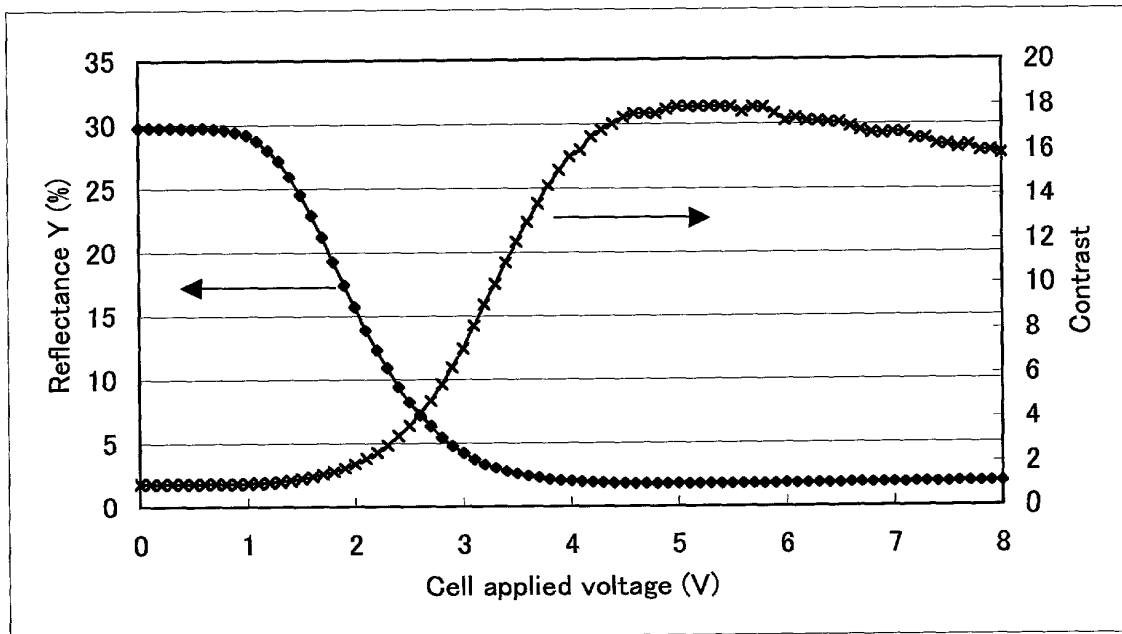
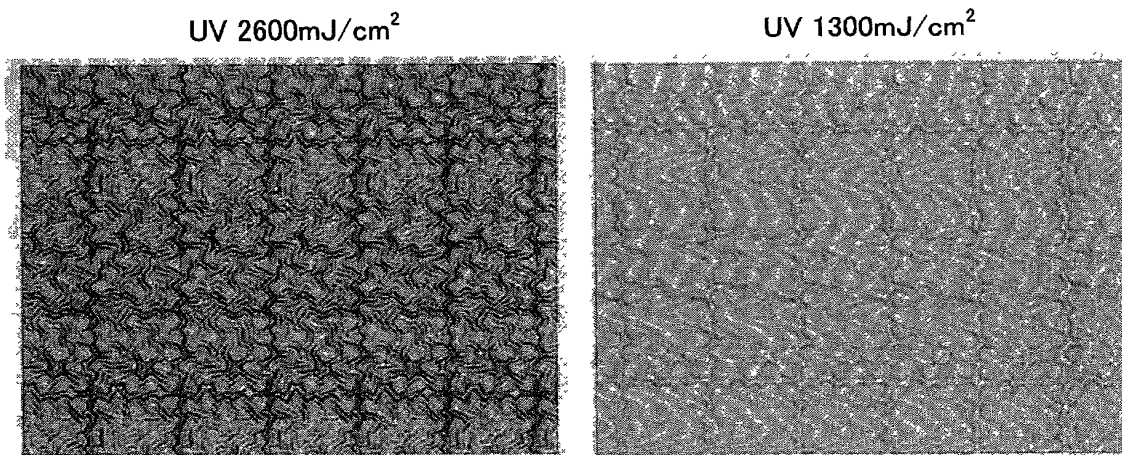
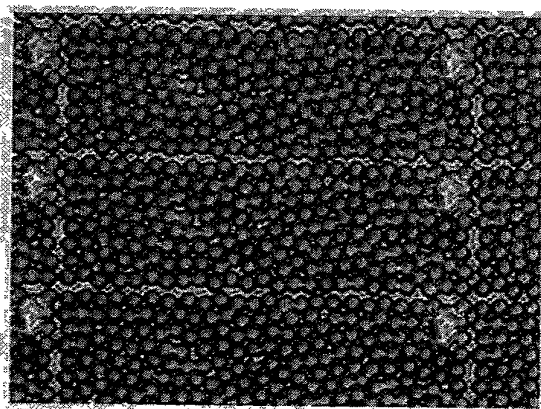


FIG. 79



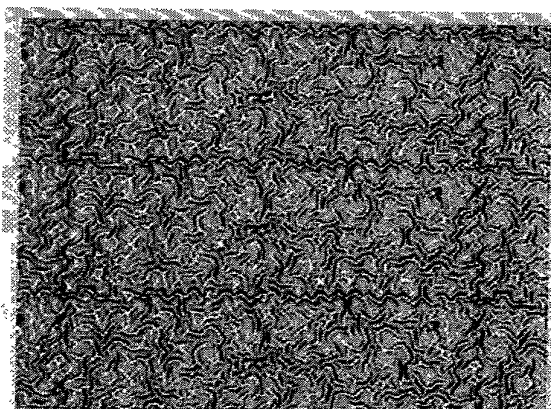
20 ×

FIG. 80A



UV 80mJ/cm²

FIG. 80B



UV 35mJ/cm²

FIG. 81

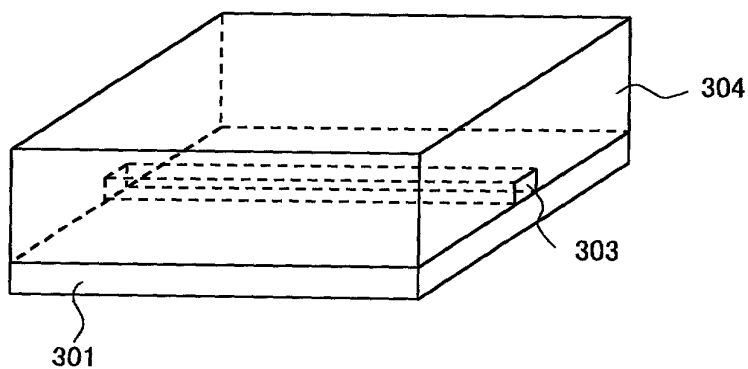
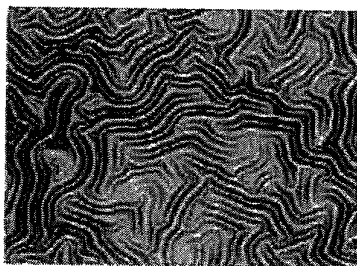
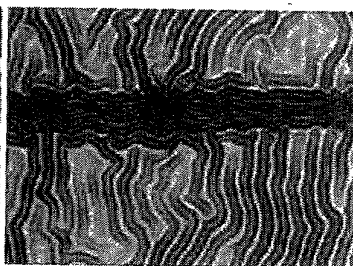


FIG. 82A



No undulation under resist

FIG. 82B



Undulation under resist

← Stripe undulation

20x

FIG. 83A

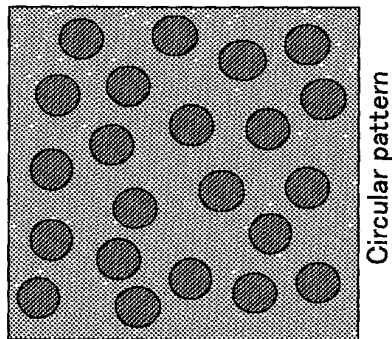


FIG. 83B

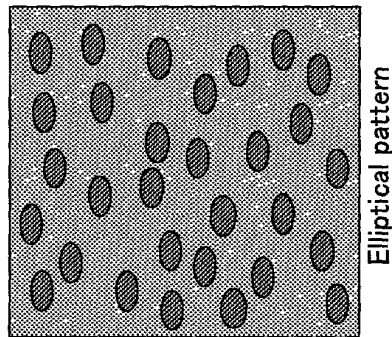


FIG. 83C

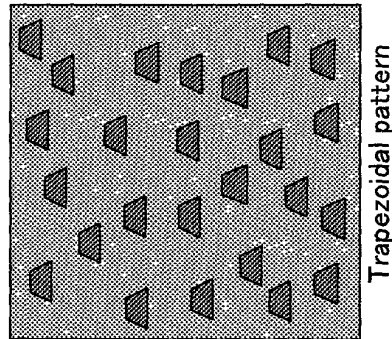


FIG. 83D

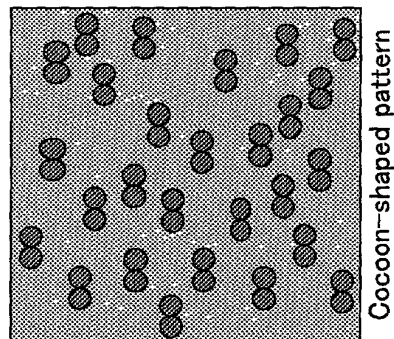


FIG. 83E

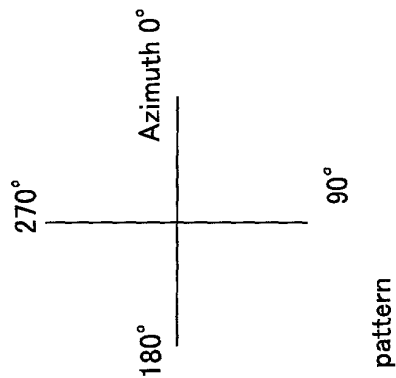
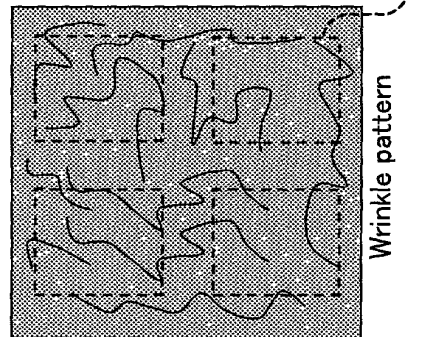


FIG. 84A

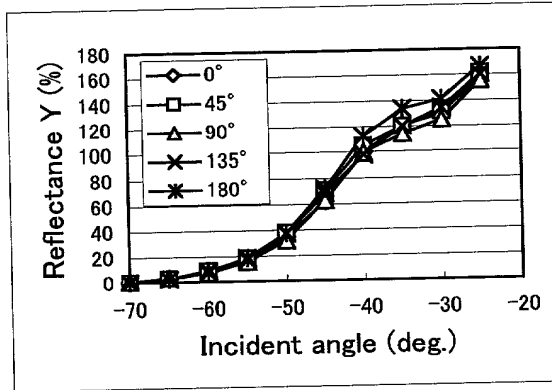


FIG. 84B

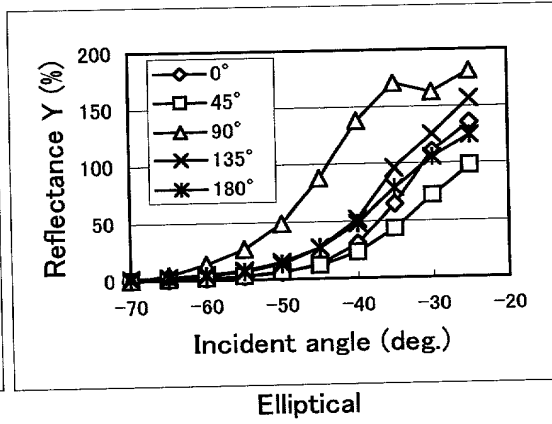


FIG. 84C

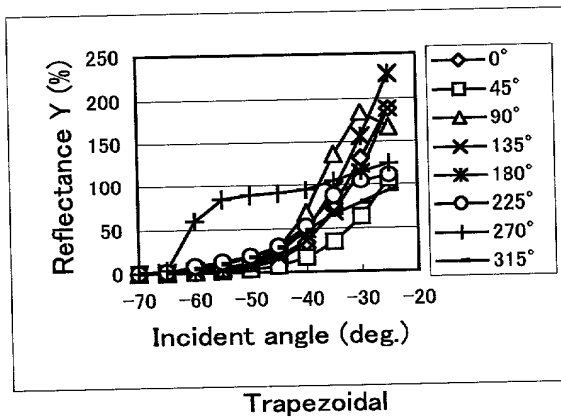


FIG. 84D

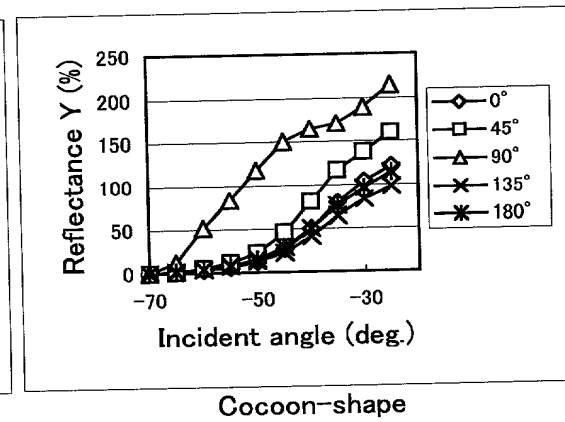


FIG. 84E

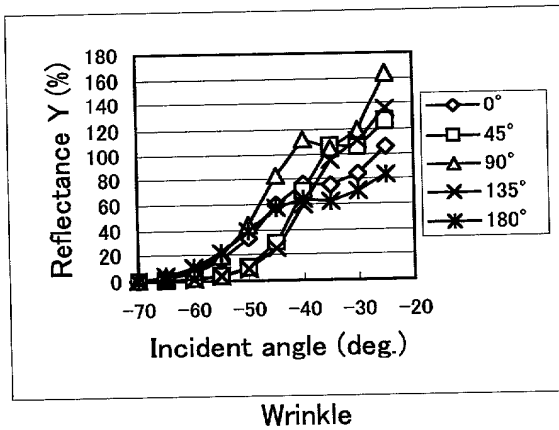


FIG. 85

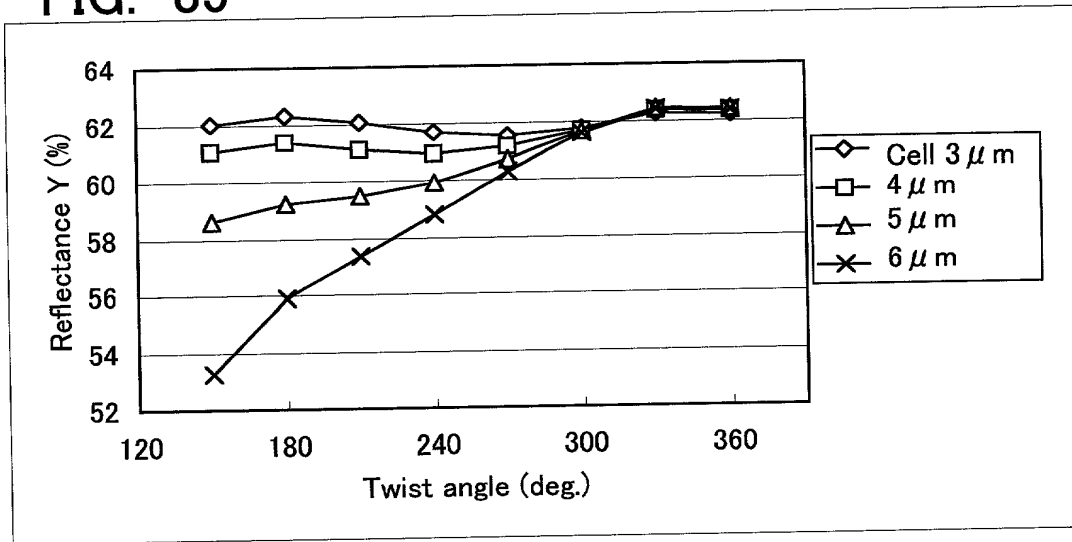


FIG. 86

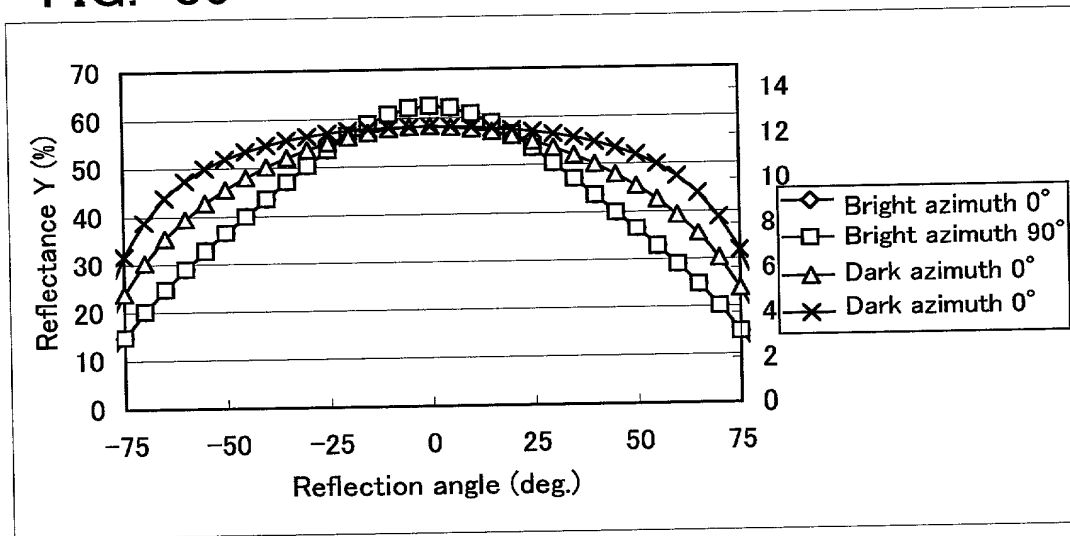


FIG. 87

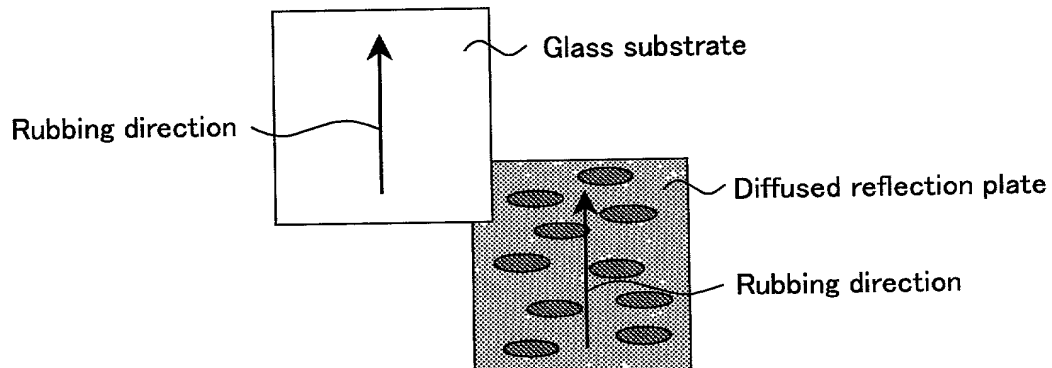


FIG. 88

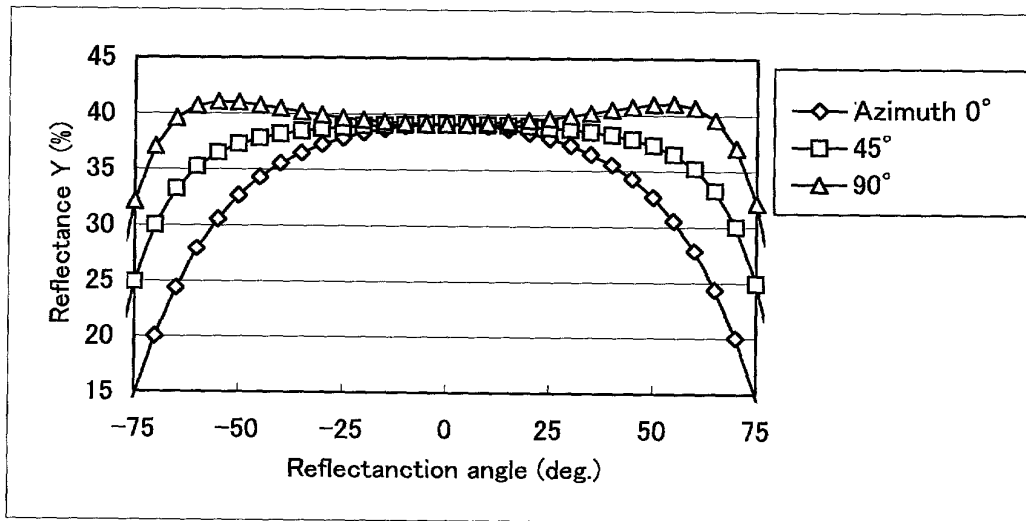


FIG. 89

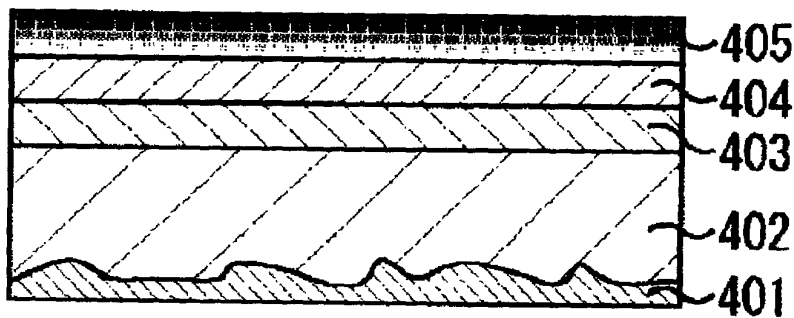
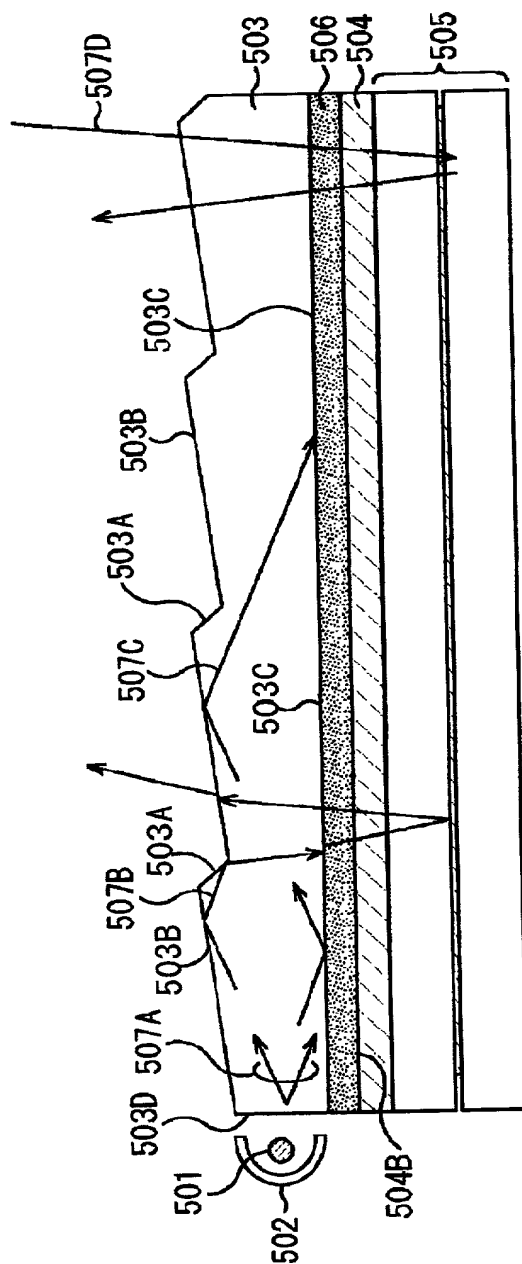


FIG. 90



208TFO" 604T500T

FIG. 91

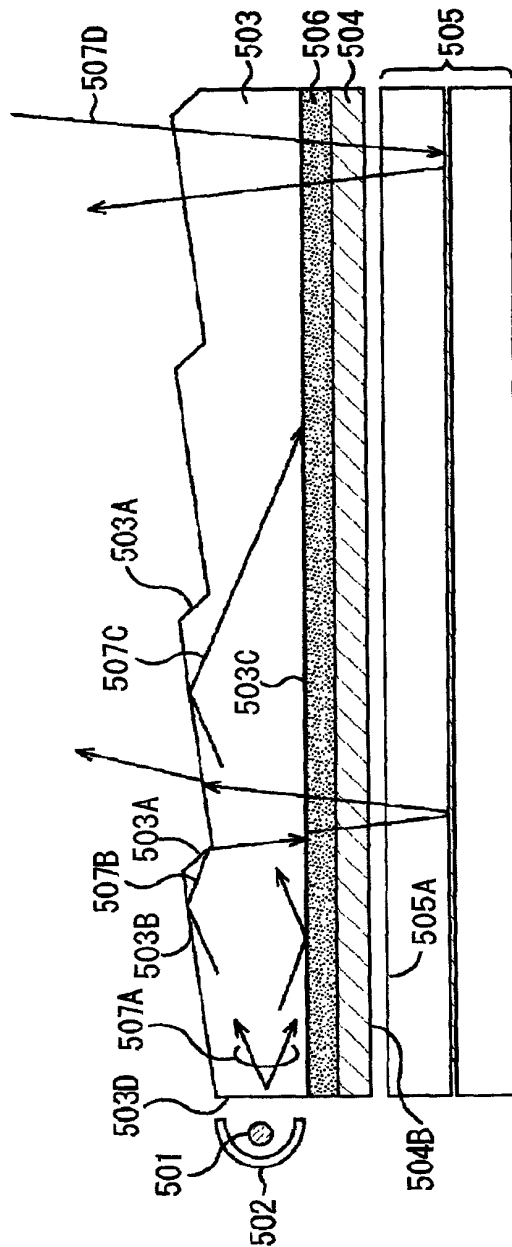
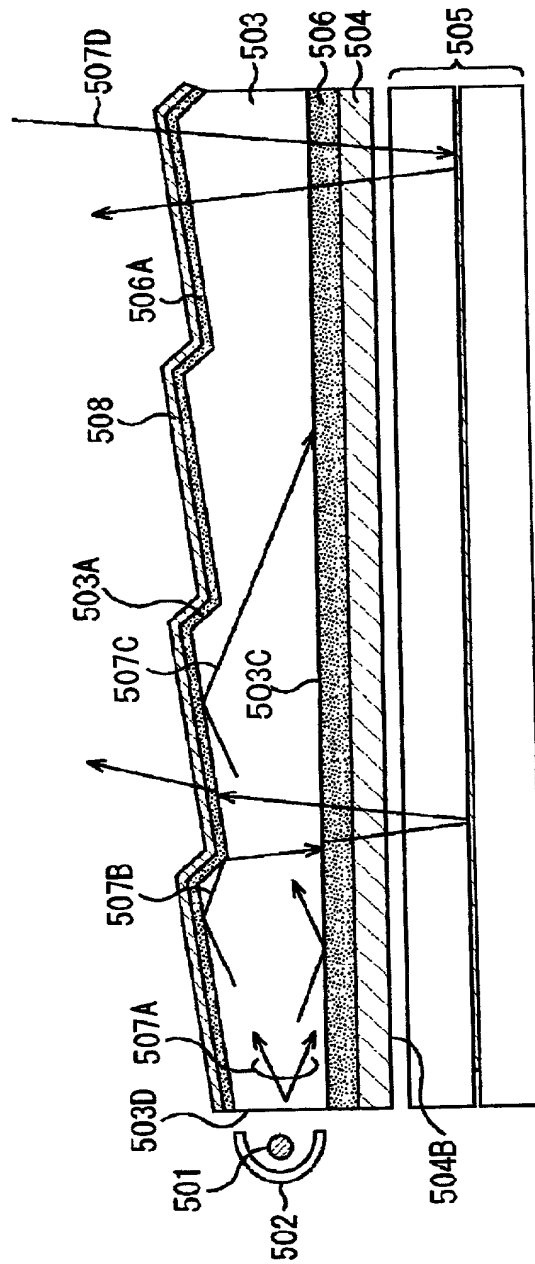


FIG. 92



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FIG. 93

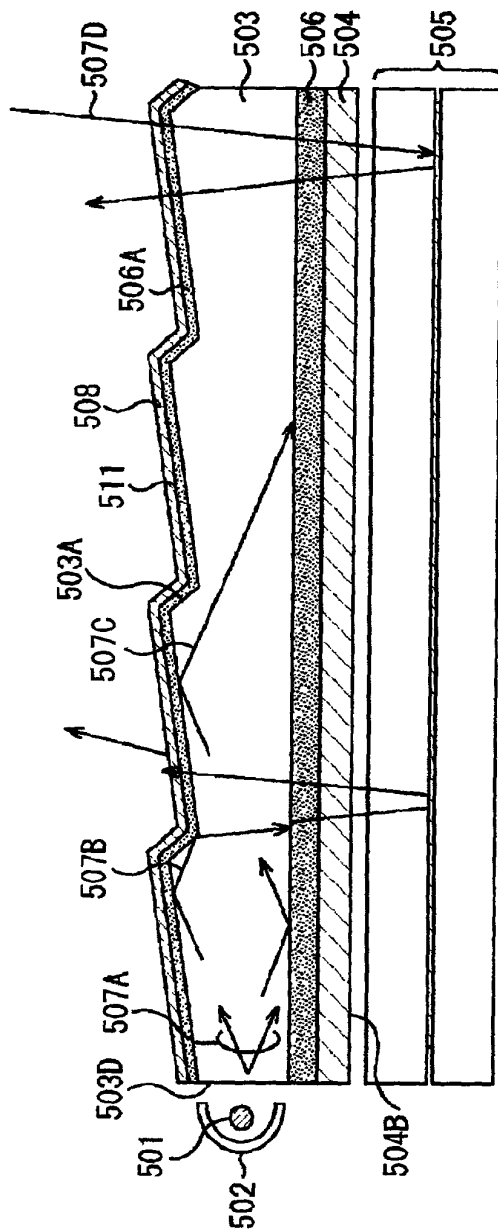
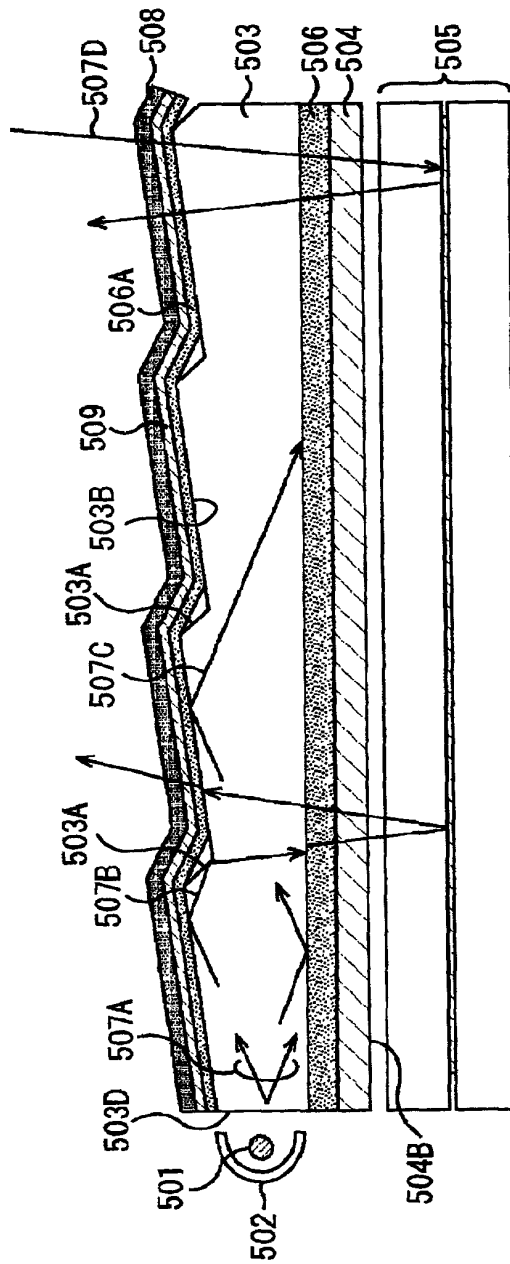


FIG. 94



208770" 504T500T

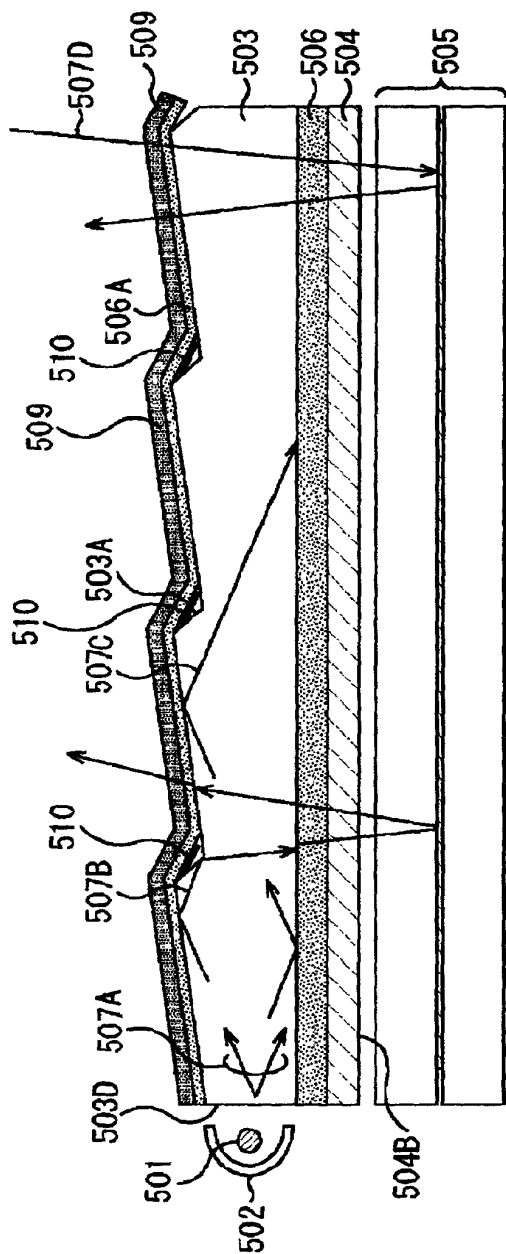


FIG. 95A

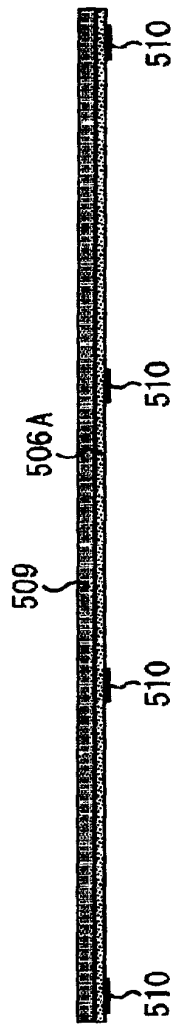


FIG. 95B

FIG. 96

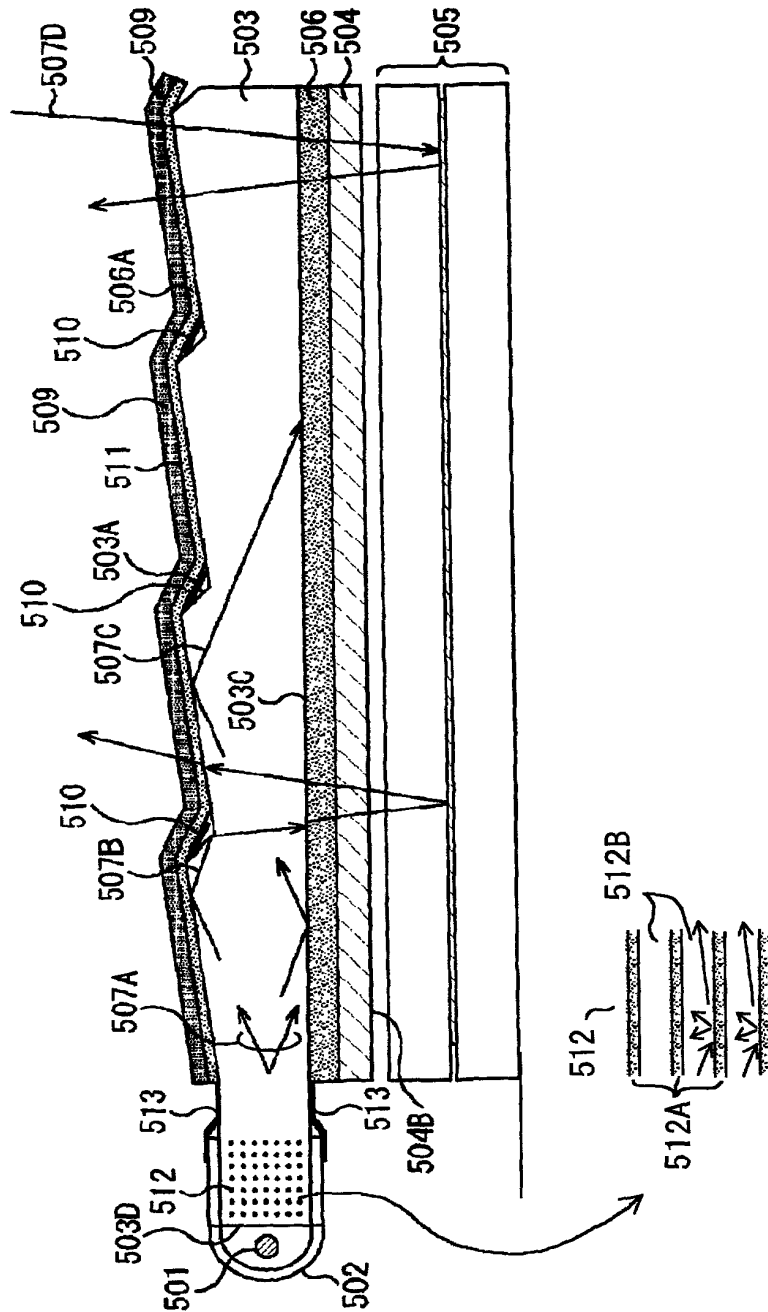


FIG. 97

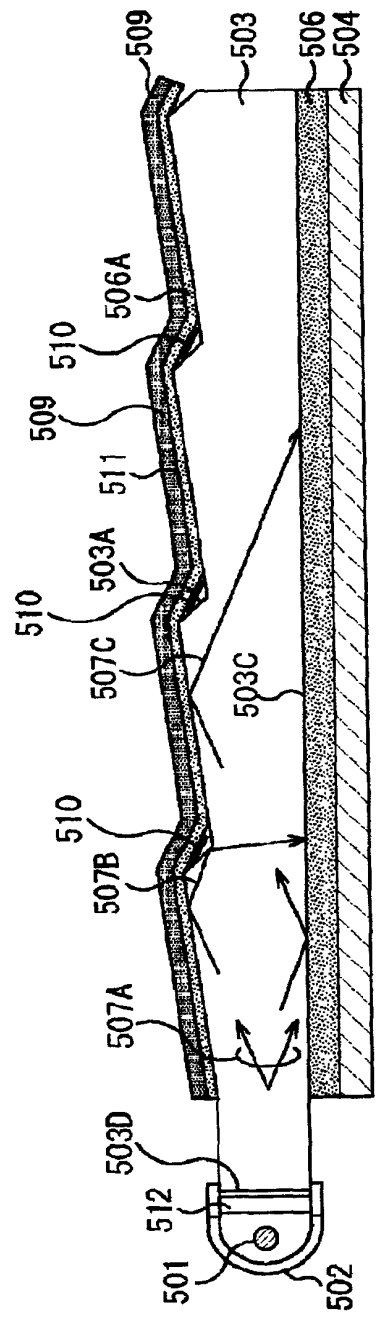
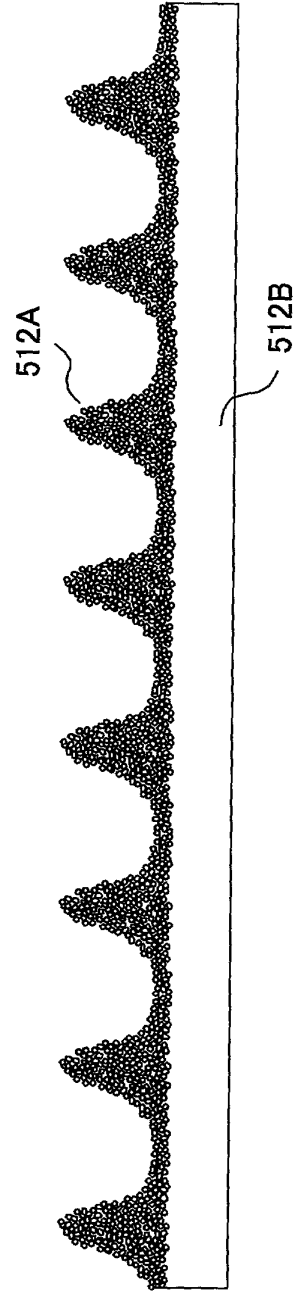


FIG. 98



20870" 604FS007

FIG. 99

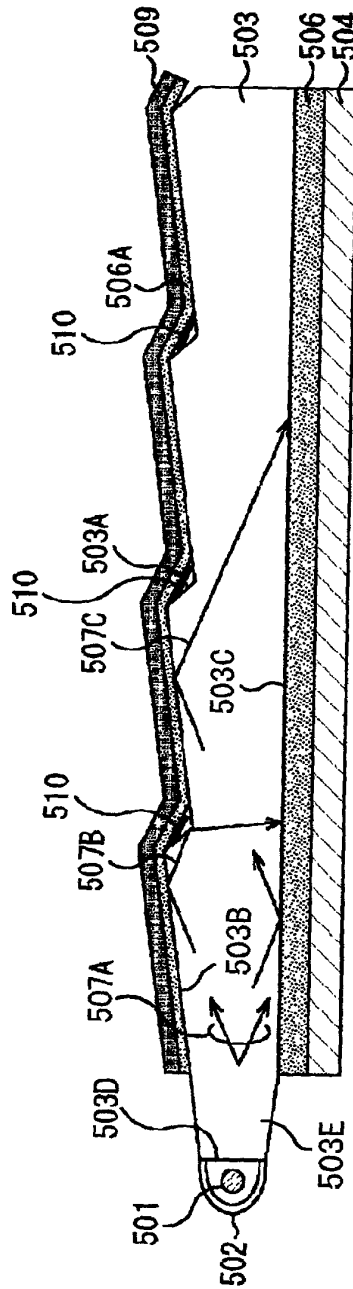


FIG. 100

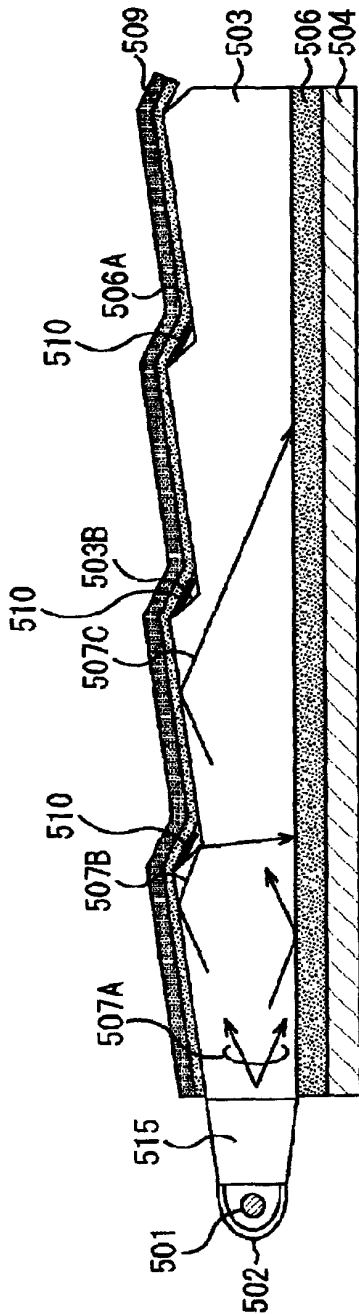


FIG. 101

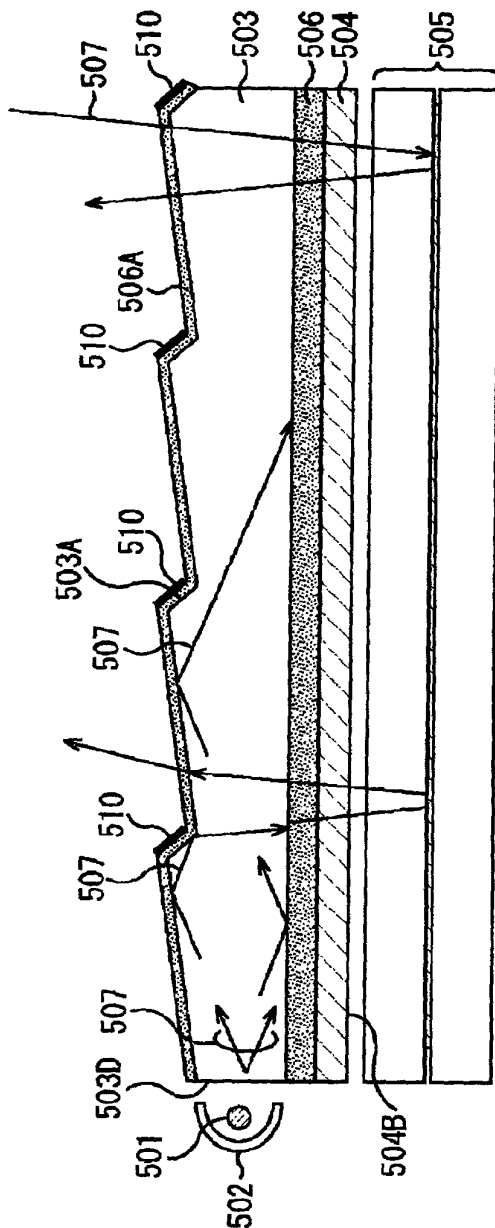


FIG. 102

